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CONTENTS

	Page
The Housing of Scientific Societies	703
The British Scientific Instrument Industry	704
Initiation into Modern Logic. By Dr. S. V. Keeling	706
Role of Vitamins in Plant Physiology. By Dr. R. D. Preston	707
Eratosthenian Averages. By Prof. G. H. Hardy, F.R.S.	708
Anthropology in Reconstruction. By Prof. F. C. Bartlett, C.B.E., F.R.S.	710
Blood Pigments and Related Substances	714
Obituary:	
Dr. W. H. Hatfield, F.R.S. By Dr. C. H. Desch, F.R.S.	716
News and Views	717
Letters to the Editors:	
Non-Solar Planetary Systems.—Sir James Jeans, O.M., F.R.S.	721
Non-Solar Planets and the Origin of the Solar System.—Dr. H. Alfvén	721
Mutation and the Rhesus Reaction.—Prof. Lancelot Hogben, F.R.S.	721
An Interferometric Procedure for the Examination of Crystal Surfaces.—Dr. S. Tolansky	722
Use of Radon to Trace the Flow Pattern of Gases in Furnaces.—R. Mayorcas and M. W. Thring	723
A New Water-Soluble Polysaccharide from Perennial Rye Grass Pasture.—R. J. McIlroy	724
Microbiological Assay of Riboflavin.—Prof. R. H. Hopkins	724
A Penicillin-like Substance from *Aspergillus giganteus* Wehm.—Mrs. Flora J. Philpot	725
Lipæmogenic Activity of Pituitary Extracts.—M. R. A. Chance and T. R. Middleton	725
Binocular Focusing on a Repeating Pattern.—Nellie Henderson	726
J. B. Hannay and the Artificial Production of Diamonds.—Prof. M. W. Travers, F.R.S.	726
Subdivision of Insecta Pterygota into Subordinate Groups. By Dr. B. N. Schwanwitsch	727
Geology in the War and After	728
Scientific and Industrial Research in Australia	729

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THE HOUSING OF SCIENTIFIC SOCIETIES

AT a time when plans of reconstruction are being everywhere projected, it was fitting that Sir Henry Dale, in his presidential address to the Royal Society (see NATURE, December 4, p. 649), should put in a claim for more adequate and dignified accommodation for science. Men of science do not require to be told how meanly housed are many of the scientific societies in Great Britain; they can be forgiven a feeling of envy towards their colleagues in other lands where science has been made to enjoy an honoured place in the scheme of national life. It is pertinent to inquire why this should be. We believe that the real root of the matter is that false philosophy which refuses to regard science as a normal way of life in a modern community. To say this does not mean that we claim priority treatment for science; we demand no more than a recognition of the debt which any modern State owes to scientific endeavour.

That this debt is not admitted and honoured may be partly the fault of scientific men themselves. They have sometimes been too prone to seek refuge in a sort of splendid intellectual isolation; they have neglected—some would assert wilfully—the methods of advertisement which art and the drama, music and literature, have employed to stake their claims in the life of the modern State. Speaking a language which is not always understood by ordinary people, they have suffered from being misunderstood; and such a state of affairs is made the easier when the machinery of government and the organs of public opinion—the Press and radio—are guided by men who have too frequently been denied a scientific background to their education.

In general terms, Sir Henry Dale gave some indication of the debt which Great Britain owes to science in war. The Press at once seized upon his words, that to-day the United Nations are superior to their enemies in scientific achievement; the man-in-the-street, had he not read those words, would have been the first generously to recognize that science in war has given life and property a greater protection than was known when enemy bombers raided his towns and cities nightly. At some other time, no doubt, Sir Henry Dale will tell our people how much greater can be the achievements of science in peace, and particularly in those vital years which will follow victory, when great works of reconstruction will have to be carried out on a world-wide basis. Such a pronouncement will hearten all those who have faith in the future.

But the efforts of scientific men to assist in the fabrication of a better world merit a frank admission of the claim for better accommodation for the scientific societies. These societies were founded to enable men of science to meet together to discuss common problems, and the part which they have played in the advancement and dissemination of scientific knowledge is incalculable. The State recognized the importance of the societies in 1778 when it granted the Royal Society accommodation in Somer-

set House; and Sir Joseph Banks, in his presidential address of 1780, boldly declared that the Society's new home was a "generous recognition by the sovereign of the services which science had rendered to the state". Later, the State admitted the claims of some of the younger societies for accommodation, and still remains in the status of their landlord. We can deplore the lost opportunities of the middle years of the last century, when for a moment it seemed as though London was to be ennobled by a great centre for science. That was one of the grand visions of the Prince Consort; and none was more eager to clothe it with reality than Sir Charles Barry, the architect. The latter's scheme, propounded in 1859, for the development of the Burlington House site, indicates how much London lost by its rejection by the Government of the day. Science lost too; but it is very doubtful whether even Barry's scheme, designed as it was in the grand manner, would have met present-day needs. No one then suspected that the Chemical Society would increase its membership from about 500 to 5,000: as Sir Henry Dale observed, no one then suspected even a future for physics! Increase in membership and better facilities for publication have resulted in an expansion of libraries which was unthought of in the days when the societies moved into Burlington House.

What is the solution? In the first place, the State must be made to appreciate that science has a right to adequate and dignified accommodation in the metropolis. We can but reiterate the words of Sir Henry Dale. "I do not think that we must stand by and allow the claims of science again to go by default. A fear of overstatement, a passion for critical accuracy which is part of the very spirit of science, may make us reluctant advocates. If necessary, however, we must be ready to remind all who may be concerned of the part which the British scientific effort has played in making it possible now to plan at all, with confidence, for our own civic and national reconstruction. But for science, we may remind them, the very different plans which our enemies were so recently making for our future might already be taking effect".

Sir Henry is right in thinking that the claim will, no doubt, be frankly acknowledged: it will certainly be by the ordinary man, but only when he is educated to know more about the nature of the claim. That this can be done has been abundantly proved in the U.S.S.R., where science has a real 'news value' in the Press and over the radio: it is an experiment which might properly engage the attention of scientific men in Great Britain. The scientific societies would not fail to benefit from it.

In the second place, any scheme for the rehousing of the scientific societies must leave room for expansion. The experience of the past has shown us that adequate accommodation to-day becomes inadequate accommodation to-morrow. No doubt a certain amount of rationalization can be effected, for example, in libraries and publication activities, thereby preserving a proper economy of space. But what is imperative is that the State shall immediately tackle this pressing problem. Again to quote Sir Henry Dale: "I think that we have the further right to expect that the home of science, in this capital city, will have a dignity symbolizing its value to the nation and empire, and enabling us to hold up our heads in the company of other countries, whose scientific academies, not more famous than ours, have so long been housed more worthily, and with a more generous recognition of their due place in an enlightened people's scale of cultural values". These are words which ought to be pondered by those who are now engaged in framing a policy of replanning for London.

THE BRITISH SCIENTIFIC INSTRUMENT INDUSTRY

ONE of the immediate results of the harnessing of the whole of the man-power of Great Britain to the war effort has been to engender an almost universal appreciation of the vital part played by scientific instruments in a nation's life. No longer is the scientific instrument an obscure device to be used only by the expert and to be understood only by the specialist. Rather, to the men and women of the factories and of the Fighting Services, it has become a familiar and essential tool, the use of which makes them masters of complicated mechanisms and processes and enables them to achieve, both in the workshop and in combat, a most satisfying degree of precision. The nation has, in fact, become instrument-minded, and this should hearten those who, by the written and the spoken word, have in recent times pleaded for a more vigorous application of science to our national life. For the scientific instrument is one of the main vehicles by means of which the fruits of science are made available to the ordinary citizen, and the general public has, as never before, first-hand evidence of the value of the application of science as it appears concretely embodied in the scientific instrument of daily war-time use.

The circumstances and conditions of the War should have compelled the nation to make the maximum use of its scientific knowledge and of its scientific personnel, and it is not surprising that a belief should have become general that they could be employed equally advantageously when the nation is confronted with its post-war problems even if the nature of these can only be conjectured. In consequence, reports have been prepared dealing with improvements in scientific education, with the provision of the right type of technical personnel for industry, with the necessity of increasing the scale of both academic and industrial research, and with many allied subjects. A point to be observed is that if the high hopes entertained of the adequate use of scientific knowledge in the future are to be realized, if research activities are to be markedly increased, if the scientific control of industrial processes is to be fully developed, and if scientific education is to be modified so as to provide an effective channel for the infiltration of scientific knowledge into the national life, an adequate supply of scientific instruments, suited to each and every purpose, must be available.

The scientific instrument industry should be so progressive in spirit and so efficient in technique as to be able not only to meet these potential heavier demands, but also to develop and to produce new types of instruments incorporating in their design and principles of operation any new phase of scientific knowledge of practical application. The moment is therefore opportune to review and to take stock of the scientific instrument industry in Great Britain, and an immediate occasion is provided by the issue of a handbook of the Scientific Instrument Manufacturers' Association of Great Britain, Ltd.

It is instructive to be reminded that the early scientific men were their own instrument makers, and that in the seventeenth and eighteenth centuries the historic names of science were associated with instrument invention and production. Many of Sir Isaac Newton's investigations were carried out with instruments made with his own hands; the same may be said of Robert Hooke and later of Sir William Herschel. It was in these early days of modern experimental science that the origins of the British scientific instrument industry are to be found. Instrument-making firms were established in Newton's time and at an even earlier date, two, at least, of which survive to this day. As Mr. R. S. Whipple points out in an interesting article in the handbook, the increase in the numbers of workers in the scientific field created a demand for skilled and professional instrument makers, but even up to very recent times the experimental scientist evinced a keen interest in instrument design and development. One need only mention the instruments associated with the name of Lord Kelvin and the existence of instrument firms the boards of which, a generation ago, were composed almost completely of men of professorial standing. New advances in scientific knowledge frequently lead to the eventual creation of new types of instruments, and one obvious advantage of the close association of the scientific man with the professional instrument maker lies in the probability that by it the implications of a scientific discovery in the field of development will not be ignored for an unnecessarily long period. It is perhaps unfortunate that in recent years the links between the scientific worker and the instrument maker have, in Great Britain, become weaker; in some countries they have been strengthened. The reputation of British scientific instruments was never greater than when the great names of science were linked with scientific instruments, and the prestige given to the industry by that association still remains a lively asset.

The pioneer work of British instrument makers should not be forgotten and can be remembered with much satisfaction. The science of surveying owes much to Jesse Ramsden and to William Simms, and that of photography to Andrew Ross and to Dennis Taylor. A notable contribution has been made to the development of the microscope and telescope, while in the science of electrical measurements the names of Faraday, Maxwell, Wheatstone and Kelvin will be for ever remembered. Moreover, this pioneer work was accomplished in the high days of craftsmanship, and among the traditions with which a long and honourable past has endowed British instrument manufacturers, none is of greater worth than that of the highest standard of workmanship. While it is true that the quickened tempo of modern industrial life no longer permits the use of methods by which each individual instrument becomes a monument to the craftsmanship of the worker, there yet remains in the manufacture of instruments of precision ample scope for the display of workmanship of the highest quality. During this War, the Services owe much to the compelling force of conservative tradition which has not allowed workmanship in the instrument industry to fall a victim to the claims of production, but has insisted that instruments shall have that distinctive quality which craftsmanship alone can give and that standard of performance so essential in creating confidence in the mind of the user.

The achievements of the industry during the War are too obvious to require enumeration. As has been remarked, there exists a common knowledge of the importance and ubiquity of scientific instruments in both the industrial and the combatant spheres, and the scale of production of instruments is well appreciated. It is a truism that 'instruments are the eyes and the ears of ships and aircraft and the nerve centres of armies and navies in attack and defence'. A special word should, however, be said of the work of the optical instrument industry. The manufacturers of optical instruments are in the unfortunate position of producing goods which are in no sense perishable. The equipment of a laboratory with, say, microscopes, serves not for one, two or even five years, but for a generation. The elderly Service officer even now boasts that his prismatic binoculars served him well throughout the War of 1914–18 and are rendering excellent service in the present one. The size of the optical instrument industry can never be commensurate with the importance of its products, and yet in war-time the demands made on the industry are insatiable. The proportionate minimum requirement for skilled workmen and craftsmen is probably higher in the optical instrument industry than in any other, but in war-time man-power boards are apt in this respect to regard any minimum as largely excessive. In spite of its original limited capacity and of the large dilution of its skill with inexperience, the optical instrument industry in Great Britain has successfully met the demands which have been made upon it, and has done so while still retaining to a very large degree its traditional insistence on good craftsmanship and high instrumental performance. Notwithstanding its inflation, the industry has not lacked adequate British supplies of the various types of optical glass, the quality of which has not been excelled anywhere or at any time. It is appropriate here to pay a tribute to the work of the Inter-departmental Scientific and Technical Committee on Optical Glass and to the wise planning which inaugurated that Committee.

The future of the scientific instrument industry in Great Britain cannot be considered without reference to the closing period of the War of 1914-18. It is generally believed, and hoped, that the circumstances and conditions of the latter half of the year 1918 are

reappearing. The immediate future will show whether this be true in the military sphere, but it is certain there was then, as now, a 'stirring of the waters' in regard to the urgency of a greater application to industry of science and its principles, and the same realization of the dependence of such application on an adequate supply and use of scientific instruments. It was at that time that the research association movement of the Department of Scientific and Industrial Research came into being, and the British Scientific Instrument Research Association was formed in that year. Then, as now, an expanded and efficient scientific instrument industry had arisen which had met all the demands of war and seemed capable of satisfying all requirements of the post-war future. It is now a matter of history that the response of industry in general to the opportunity presented by the Government's sponsorship of research was only half-hearted. The instrument industry, and in particular the optical instrument industry, dwindled to its pre-war level, and, more lamentable still, much of the new skilled labour which had been developed within the industry was irretrievably lost.

Into the special conditions, which it is fervently to be hoped will not re-occur, and which resulted in the years following the war being particularly lean ones for the instrument industry, it is not proposed to enter here, nor is it appropriate to consider the measures, involving high policy, which might be taken to prevent their recurrence. Rather will it be assumed that the immediate future will witness a marked evolution in scientific education and a revival of intense research and development activity in industry. In the Report of the Committee of the Privy Council for Scientific and Industrial Research, 1927–28, the following statement occurred: "The British Scientific Instrument Industry occupies a peculiar position. Its direct economic importance is small, but its indirect value is out of all proportion to its size. We shall not be far wrong now in regarding the sales of scientific instruments as a measure of the health of our chief manufacturing industries." This statement is obviously true, although the words "and of scientific progress and education" might well be added to it. The responsibility of the scientific instrument industry to industry in general is apparent and, of all industries, it should be research- and development-minded. Since 1918 the industry has maintained, with assistance on generous terms from the Department of Scientific and Industrial Research, its Research Association, albeit on a modest scale. The Research Association has carried out both basic and immediate investigations into the problems of manufacture of instruments and of the processes employed in manufacture, the results of which have been of great benefit to the industry, and the full fruits of which have been realized during the War.

There is a feeling within the industry, however, that it should maintain a research association which would operate on a scale, not determined by the limited resources of the industry in the past, but rather by the position of high responsibility of the industry. The basic research of such a research association would provide the material on which the development departments of individual firms would build, to the benefit both of the manufacturing industries and of education. It must be remarked, however, that the Services, industry and education each has a responsibility towards the scientific instrument industry. Nothing could be more helpful to the instrument industry than insistent demands made upon it from outside. These demands should include the provision of all types of instruments, adequately to equip British industry with the scientific tools of control and research, and to give to scientific education an added practical value which will ensure that suitably trained personnel is available for applied science. Insistence should also be made on the early development within the industry of special instruments for special purposes, and of new types of instruments, to allow of full advantage being taken of new advances in scientific knowledge.

The handbook issued by the Scientific Instrument Manufacturers' Association shows that the whole range of scientific instruments is covered by the industry. The long and distinguished history of the industry provides a strong foundation for the hope that it will serve the generations of the new era well, and the achievements of the industry in the War give an earnest that it can meet the most insistent demands made upon it. The future prosperity of the nation demands that it shall, in fact, so do.

INITIATION INTO MODERN LOGIC

A Modern Elementary Logic

By Prof. L. Susan Stebbing. Pp. viii+214. (London: Methuen and Co. Ltd., 1943.) 8s. 6d.

THE author's aim was to provide a text-book primarily for first-year students reading logic at the universities. But the reason for that in the content and emphasis of her book which differentiates it from the usual manuals, and to which the appellation of modern in its title directs attention, may not be immediately apparent to one unacquainted with the change of orientation and the nature of the work resulting therefrom which mark the advancement of the subject since the earliest years of this century.

The source of the difference may be indicated very summarily in this way. The scope, purpose and content of the discipline traditionally associated with the names of Aristotle and Mill were determined in the main by the conception of logic as being a study of thinking (that is, of judging and inferring), or an analysis and criticism of thought, principally concerned to elicit the principles by which validity was secured for those processes. In contrast with this view, contemporary formal or mathematical logicians set aside the thinker and his thinking as irrelevant, substituting as the proper 'data' of logic the field of all possible propositions and the relations connecting them. Much as the geometer is said to take for his subject-matter lines, planes, solids, their various characters and relationships, and not his thinking about these, so the logician is invited to regard as his proper subject-matter propositions and their relations one to another, in abstraction from his

judging about them or inferring from them. In this way, logic no more than geometry is to be a study of thinking, and pure mathematics comes to be represented as simply an extension or development of pure or formal logic. Now this newer orientation and the novel distinctions and analyses traceable to it have as yet penetrated scarcely at all into university teaching and text-books of elementary logic, and by composing this "Modern Elementary Logic" Prof. Stebbing sought to amend present practice and secure that the new orientation shall be dominant in the first-year course.

Only an experienced and clear-headed teacher possessed of her mastery of the new work could have composed within so limited a space an exposition as solidly informed and lucidly expressed of the more fundamental parts of the new discipline. All in the book is admirable that appertains to precision of statement, to relevance and to the order in which the various topics are introduced. But these excellencies are compromised by two defects in particular, and they are scarcely trivial ones. In the first place, there is a lack of uniformity in the presentation, consequent upon the author changing the viewpoint from which she treats her material. Though she adheres for the most part to the 'modern' viewpoint (which substitutes proposition for process), she sometimes forsakes it and adopts the 'traditional' one. The objection here is not, of course, that some of the *matters* treated in her book (for example, variations of mental attitude in judging; syllogistic reasoning) belong to the body of traditional logic. It is that they are treated in the same *manner* as that in which traditional logic treats them: that is, in a manner which presupposes the 'traditional' point of view and not the 'modern' one. Consequently we find, not one mode of treatment consistently pursued from first to last, but two unharmonized modes of treatment; a treatment from one viewpoint of certain matters (which have also been traditionally expounded), and a treatment from a different viewpoint of other matters (some of which were not expounded in traditional logic). That is to say, she passes from a point of view which presupposes as 'data' nothing but propositions and their relations, to the other point of view which presupposes thinkers and their mental activities of judging and inferring. To ask whether this inconstancy is symptomatic of anything profounder than a blemish in the logical purity of the exposition or statement would be to raise a large issue in epistemology. But it does affect the book's claim to being 'modern' in the special sense indicated, though it will cause no embarrassment to the first-year student, nor, provided his examiners are 'modern-minded', will it diminish the book's usefulness in preparing him for examination.

This last, however, can scarcely be affirmed of the second defect to be mentioned; namely, the very inadequate space accorded to induction and methodology. All that the author has to say on this extensive branch of logic is packed into twenty pages, or one ninth of the whole book. She admits that her readers will have to "consult other textbooks" about the detail of induction and methodology. But should not a text-book on logic "intended for first-year students" comprehend all that is essential for the first-year examination? It is no solution to crush the exposition and illustration of matters that make up so much as half the student's whole syllabus into one brief final chapter, and then refer him to other sources for what is wanting. This unwarranted curtailment is regrettable for the further reason that it may only too easily give the beginner the false impression that logic is almost wholly occupied with the demonstrable and certain, and scarcely at all, save in a quite secondary way, with the problematic and its criteria. One inclines to suppose that it is the author's lively interest in mathematical logic that led her to devote so inordinate a proportion of her space to formal doctrine, otherwise the room taken up in expounding a number of technical distinctions that are of no vital concern to a beginner (for example, that between 'entailment' and 'material implication') would have been used to discuss and illustrate more fully what is unquestionably of far greater importance to him.

To sum up: taking the chapters one by one, each certainly succeeds in conveying a great deal of information in short compass and without congestion. But taken collectively, those chapters make up an ill-balanced book. Specialist enthusiasm seems to have been responsible for injudicious selection. However important a contribution to one special department of the subject these Russellian developments may be, it seems undesirable to incorporate them so immoderately in a first-year text-book that they form the bulk of the logic with which the beginner first becomes acquainted.

S. V. KEELING.

ROLE OF VITAMINS IN PLANT PHYSIOLOGY

Plants and Vitamins

By W. H. Schopfer. (A New Series of Plant Science Books, Vol. 11.) Pp. xiv+300. (Waltham, Mass.: Chronica Botanica Company; London: Wm. Dawson and Sons, Ltd., 1943.) 4.75 dollars.

FEW studies in biochemistry have aroused such popular interest as the remarkable advances made in recent years concerning the dependence of animals on small doses of those substances, produced mainly by plants, which we call the vitamins. It is natural that the marked heterotrophy for these substances in man has stimulated interest largely in the vitamin aspects of animal nutrition; but it has always seemed anomalous that the importance of vitamins to the plant which makes them, realized only vaguely even by many botanists, has not had wider publication. This gap has now been filled in this remarkable book, and it is well that the first major review should come from the hands of an expert, and indeed one who may be said to be the founder of the modern science of plant vitaminology. His book is, as it must be, of the nature of a preliminary report on a subject now in the full tide of development; but it tells, in an orderly way, of all the important advances made in the ten years since Schopfer (1934) first showed the necessity for vitamins in the culture of Phycomyces, with sufficient bibliography to enable enthusiasts to find other sources of information. It is further very satisfactory that the author, though not hesitating to reproduce and discuss the structural formulæ of the vitamins and to emphasize the vitally important, if purely chemical, aspects of vitamin structure, does not fall into the trap of making the work biochemical. It is a book written by a plant physiologist for plant physiologists.

Ever since the introduction by Wildiers in 1901 of the concept of bios, plant physiologists have tended to remain aloof, and to explain the apparent necessity

for traces of organic growth substances by plants grown in artificial media as due merely to some fault in the composition of the mineral nutrients and organic foods presented to the plants. This is a natural and healthy reaction, and it is clear that some workers on the growth-substance concept have been hasty in their conclusions. Few doubts can remain after reading this book. The author, in the chapter on methods, points out these possibilities of error at some length, and details the many reasons, apart from lack of growth substances, for which a plant will fail to develop on a purely synthetic medium; in fact, he sometimes leans away from the growth-substance concept himself as, for example, on p. 78, where he says of the germination of pollen: "Natural riboflavin is the most active substance on pollen but, since it is contaminated by boron the activity must be attributed to the latter". It is not, of course, clear that all workers adopt the rigorous attitude of Prof. Schopfer, and some of the investigations recorded in this book will scarcely satisfy the reader (for example, the supposed function of asparagine as a cofactor on p. 105), but the careful consideration given to cultural conditions by the author himself leads the reader to accept his opinion with some confidence in most cases.

Experiments have been carried out on very many species at all phylogenetic levels, and in many cases the vitamin requirement worked out in considerable detail by the use of synthetic as well as natural preparations. Auxo-heterotrophy has been demonstrated clearly in many species, among green plants as well as non-green and even in roots of the flowering plant, and is clearly due to a loss of the power to synthesize some essential vitamin. Apart from the very thoroughgoing determination of the necessity for specific vitamins, the author assesses very carefully and logically the bearing of his findings on problems of sexuality in plants, of symbiosis, of parasitism; and many other points of physiological importance are touched upon throughout the book.

The subject naturally divides itself into three subsections, and this division is adopted in the book. Section 1 deals with plants which can synthesize vitamins; Section 2 with plants which cannot; and Section 3 with general physiological problems involving vitamins, of the type mentioned above. In Part 1, after a study of methods, the principal vitamins synthesized by plants are discussed, together with as full an account of their action on plants as present knowledge will allow. In Part 2 follows a detailed discussion of each of the vitamins concerned: thiamin, riboflavin, pyridoxine, nicotinic acid and nicotinamide, ascorbic acid, carotenoids, etc., and their effects on plants which have lost the power of synthesis, as well as a brief excursion into the effects of animal hormones on plants (particularly of œstrone, the only one with any marked effect). The interplay of various growth factors is emphasized in many cases, and special mention may perhaps be made of the useful discussion of the nitrogen-fixing and lactic acid bacteria. The discussion of each vitamin includes the capacity of various plants for synthesis, the specificity of the vitamin and its function in the plant. It is now evident that most, if not all, vitamins operate as coenzymes, or part of coenzyme systems, in the respiratory processes of plants, and this point is well emphasized throughout the book. The third part attempts an analysis of the importance of vitamins in agriculture and horticulture, and a study of parasitism, etc., already mentioned. Lack of precise and wide knowledge makes this the shortest section, but it is in many ways the most interesting, for it shows the way to future fields of great promise. The last chapter is of particular interest to plant physiologists working in related fields, for in it the author attempts to set up a series of micro-organisms as test objects in the study of vitamins.

Apart from a few words of variable spelling (for example, 'thermostabile' and 'thermostable') and one or two sentences the meaning of which is obscure (for example, p. 96, "It is unusual that the fruits richest in carotenoids are frequently the richest in ascorbic acid . . ", meaning actually that carotenoids and ascorbic acid are usually associated) the translator is to be commended on his performance of a task of peculiar difficulty. Prof. Schopfer's book cannot fail to make a wide appeal. His subject is a meeting ground of many specialized sciences—organic chemistry, enzymology, animal and plant physiology, microbiology—and all these meet here to solve problems which are fundamental. His book should therefore be well received as a clear and thoroughgoing exposition of this new field. R. D. PRESTON.

ERATOSTHENIAN AVERAGES

Eratosthenian Averages
By Aurel Wintner. Pp. v+81. (Baltimore, Md.: The Author, Johns Hopkins University, 1943.) 2 dollars.

THIS is a curious and interesting little book, though unlikely to appeal to a wide circle of mathematicians. The author makes heavy demands both on the intelligence and the knowledge of his readers, and his English, though usually 'correct', is English of a very 'continental' type, overpacked with allusions, parentheses and qualifying clauses. A good deal of allowance must be made for the inherent difficulty of the subject-matter, but it is a pity that he could not write in a simpler and less oracular style.

I will not try to give any reasoned account of the content of the book: a few summary indications will be sufficient for any reader sophisticated enough to profit by it. He should be familiar with the outlines of the classical theory of the distribution of primes. He should know the inversion formula of Möbius, and the simpler 'Tauberian' theorems; 'density' and 'almost periodicity' should mean something to him; and he should understand what is meant by talking of theorems of different 'depths'. To such a reader I can commend a book in which he will find plenty to interest him—theorems new to him, and old theorems in unfamiliar settings. If he has not this background of knowledge, he would be more profitably employed in acquiring it.

The most attractive part is probably Part 2, in which the author develops a 'Fourier theory' of arithmetical sequences (which includes, for example, the theory of the 'Ramanujan sums'). But surely there should be some reference here to the work of Carmichael in Vol. 34 of the London Mathematical Society's *Proceedings*? I should add, in fairness to the author, that I have committed the same sin of omission myself.

Part 1 (on the 'Eratosthenian matrix') contains an interesting discussion of various implications, or supposed implications, of the formulæ of Möbius. Part 3 (on the 'statistics' of the prime number theorem) is very tough reading, but that is not primarily the author's fault. G. H. HARDY.

Microscopic Technique in Biology and Medicine

By Prof. E. V. Cowdry. Pp. iv+206. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1943.) 22*s*.

THIS is decidedly a book for the expert. It consists of an alphabetical arrangement of formulæ, references and short descriptive notes on microtechnical methods, and, as would be expected from its author, it is comprehensive, up to date and well documented. In fact, it is almost too comprehensive, for a number of subjects are included which are only on the fringe of the subject, while on the other hand some of the short articles on methods are so succinct that they suffer somewhat in intelligibility.

The alphabetical method has great advantages in some respects, where such varied material is collected together, but it is rather apt to lead the searcher on a steeplechase across the book when he wishes to get full information on a single subject. Thus "Fixatives", for example, involves sixty-four cross-references. An excellent feature, however, is the printing of all cross references in heavy type, which makes it easy to follow them up.

The first impression on looking into the book is that everything possible is here, but that is going a little too far. The temptation in reviewing such a cyclopædic work is to sigh over the absence of some of the reviewer's own pets, instead of praising the author's actual achievement, but even so, and allowing for the explicit exclusion of plant techniques, it is a pity that there is no mention of Newton's invaluable gentian-iodine technique for chromosomes, and it is surprising that Leishman's blood stain is absent, though it is still widely used.

It would be ungenerous to carp at occasional misspellings and similar trifles, but the reviewer cannot but protest, though humbly, against one more usurpation of the term "Biology" by animal science, in the title of the book. What is wrong with plain "Zoology", when plants are excluded?

Every practising microtechnician will find that this work is one that he will want to keep handy in his work-room. It will be to him of constant and, we hope, of permanent value, not least for the rich store of references it contains.

R. C. McLEAN.

The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms

A Colour Atlas and Guide. By Dr. T. Wallace. Pp. vi+116+114 plates. (London: H.M. Stationery Office, 1943.) 10*s*. net.

DURING recent years one of the most important advances in relation to the growth of field crops has been the recognition of the important part played by minute traces of elements other than those usually applied as fertilizers. Deficiency of any essential nutrient is reflected in some way in the growth and colour of the plant, and Dr. Wallace has performed a useful service to all agriculturists by collecting and describing a series of one hundred and fourteen colour photographs of various crops showing mineral deficiencies. The aim is to provide a means whereby deficiencies can be recognized and rectified at an early stage of growth, so enabling a full crop to be obtained. A scheme is indicated whereby land of unknown cropping potentialities can be tested by growing a series of indicator plants with various fertilizer treatments, the indicators being selected for their special susceptibility to a wide range of deficiencies. Where a visual diagnosis is doubtful the matter can often be settled by simple methods of spraying, responses to such treatments usually appearing within ten or fourteen days. Special attention has been given to the most urgent questions of war-time production, deficiencies such as copper, zinc and sulphur, which are not known as practical problems in Great Britain, being omitted. The illustrations, with the accompanying diagnostic key, provide a fund of most useful information.

Encyclopedia of Substitutes and Synthetics

Edited by Morris D. Schoengold. Pp. 382. (New York: Philosophical Library, Inc., 1943.) 10 dollars.

THIS "Encyclopedia" is very lavish of space; not only is it set out with a wealth of 'leads' that reminds me of much pre-war practice, but also the diction is in many places unnecessarily verbose. For example, instead of stating that atabrine is slightly soluble in water, there is a sub-heading "Solubility", and well below the words "Soluble in water only to a slight extent". The very wide spacing and the reiterated sub-headings may make for easy finding, but a more compact form of presentation, with some tables of physical constants, etc., would have reduced the size, weight and price of the volume, or allowed of the inclusion of many more uses.

A few curious statements have been noted: in referring to the production of ammonium sulphate by the destructive distillation of coal, it is asserted that "If the ammoniacal vapors are conducted into sulfuric acid and then crystallized and dried, ammonium sulphate of commerce is obtained". Calcium phosphate and calcium sulphate are both described as white powders which are found free in Nature. Despite such blemishes the book will be found useful by all who need up-to date 'potted' information on substitute and synthetic materials. E. H. T.

Dictionary of Science and Technology in English—French—German—Spanish

By Dr. Maxim Newmark. Pp. xvi+386. (New York: Philosophical Library, Inc., 1943.) 6 dollars.

THIS dictionary contains ten thousand English terms that are frequently used in the physical sciences and their applied fields, together with separate indexes in French, German and Spanish, conversion tables and technical abbreviations. The total number of entries, including cross-references, is about fifty thousand. The English part is divided into alphabetical sections (A, B, C, etc.); each word is followed by its equivalent in French, German and Spanish, always in that order, and a number. Parts containing the foreign words follow, each word bearing a letter and a number referring to the English part. An example will make this clear:

Border, chaudière *f.*; Dampfkessel *m.*; caldera *f.* . . . [354].

Chaudière, B354;

and similarly for the German and Spanish words.

This arrangement saves an extraordinary amount of space, in comparison with the arrangement usual in polyglot dictionaries. The pure sciences included are chemistry, physics and some mathematics. Of the applied sciences engineering, in all its branches, is particularly well treated, but meteorology, navigation, and photography also receive attention.

The book is a credit to the institution where it was conceived—the Brooklyn Technical High School.

E. H. T.

ANTHROPOLOGY IN RECONSTRUCTION

By PROF. F. C. BARTLETT, C.B.E., F.R.S.

I MUST confess to a considerable reluctance to repeat, word for word, a lecture which is already printed. I propose, therefore, to attempt a rather rapid summary of the printed form of my Huxley Memorial Lecture* and then to devote my attention to certain problems which could not, in that form, be considered.

I have assumed that anthropology should take a leading interest and share in all future construction or reconstruction of human society, and that if it is to do this it must enter into very much closer working relationships with other scientific disciplines, both physical and biological, than have ever so far been achieved. Further, if the claim that it can do this is to be fully substantiated, anthropology must now, and for some time to come, seek its main data in the empirical and, so far as possible, the controlled study of the behaviour of contemporary social groups.

This view is unquestionably biased and partial. It implies that anthropology is to take over and apply to whole populations those problems of the determination of behaviour and behaviour changes which psychology studies with its eye on the individual. It believes anthropology to be interested, like any other science, chiefly in causal sequences and relations within its proper sphere of study. It accepts the view that one of its primary aims is to be able to say that if any given population is submitted to particular conditions the probabilities are that these will issue in a particular sort of behaviour.

Not for one moment do I wish to suggest that these are the only problems which anthropologists will tackle. There are many others of a historical, descriptive and topographical character which have been a main concern of the subject and will, I hope, continue to be studied vigorously. But I do urge that these, especially as they affect contemporary group-life, are now of paramount importance, and should be given some priority.

The study of man is, and always has been, too vast to be a proper concern of any one investigator, of any one school, or of any one method of approach alone. Whenever it has kept close to empirical fact it has tended to split up into a number of related disciplines of study, of which four are frequently distinguished. They are: (1) physical anthropology or anthropometry; (2) the study of the effects upon group behaviour of general environmental conditions, particularly of climate, natural economic resources, lines of transport, and the size and trends of change of population; (3) the study of the applications of whatever natural knowledge is current within a group at the time at which it is being investigated and of their influence upon behaviour; that is to say, the survey of what is often called 'material culture'; and (4) the study of a group's psychological possessions, its traditions, beliefs, customs, ideals and of their repercussion upon social conduct: that is to say, of what is often, but not very well, called 'social culture'.

It may be a matter of surprise to many that I have given no specific place to archæology. This is not due to any disrespect for a wide and most fascinating field of investigation, but rather because it seems to me that archæology should either be regarded as a subject to be cultivated for its own sake, largely and inevitably descriptive, or else as a line of approach which can be adopted towards any or all of the four main branches of anthropology which I have mentioned.

On the whole, anthropometry has produced somewhat disappointing results. There are many reasons for this, but the primary one appears to be that the bodily characters chosen for measurement have, most of them, no clear and unequivocal relations to behaviour. Particularly behaviour does not regularly vary with simple changes in the size and shape of these characters. I believe that the time has come for a strong attempt to establish a genuinely functional anthropometry in which the leading idea will be to select for measurement only those characters the presence, distribution, or absence of which have a demonstrable bearing upon large-scale social activities.

For example, in the early days of the present War, it became possible to carry out an extensive survey of intelligence levels in a representative section of the population of Great Britain. At the same time, details about professional and industrial occupations were recorded. From the analysis of the results secured it can be stated reasonably accurately what are the probabilities that a person of known age in England in 1939–40 will be found within a particular occupational range. The range is a relatively large one for the middle levels of intelligence and becomes much more restricted at the extremes.

A statement of this kind is psychological. But suppose we could obtain a similar survey of intelligence levels and their distribution, in any comparable group, where new or changing developments in industry were desired, we could begin to predict what industries and professions could reasonably be encouraged within this group. That would be an anthropological statement.

The matter does not stop there. Occupational proficiency depends not only upon intelligence level, but also upon a variety of practical skills depending in their turn upon measurable qualities, or functions, of fingers, hands, arms, legs, lungs, heart, eyes, ears and central control. If we can get—a not impossible task—reliable data about the levels and distribution of these in any population, we can make our predictions of the extent and range to which occupational opportunities can be successfully stimulated within that population more accurate.

Other conditions must be studied as well, and to some of these I will turn in a moment. Meanwhile, one conclusion is inescapable. The measures required for the development of a functional anthropometry are all of them physical, physiological, neurological, biochemical and psychological. To understand the bearing of these measures upon occupation, a clinical, often a directly medical, outlook is demanded. The data are required on a large scale and their distribution is as important as their bulk. Hence the expert statistician must work on them, perhaps developing new statistical technique to do so.

When all this is done, however, from our present point of view, we have got only data and the means of assembling them. The problems remain anthropological. They require people who are able to appreciate key points in large-scale behaviour and how to deal with them. A functional anthropometry which is to be used in the service of anthropology calls now for

*Anthropology in Reconstruction. The Huxley Memorial Lecture for 1943. By Prof. F. C. Bartlett. Pp. 8. (London: Royal Anthropological Institute, 1943.) 2s. 6d. The article printed above consists substantially of the lecture as it was delivered.

a development of wider and more intimate team-work than has been achieved or even generally been considered necessary.

The study of human functions and their distribution will never give the anthropologist all he wants. Basic human activities may, for example, favour the development of heavy industries. But if climate, economic resources, lines of transport and size and trend of population are separately or together against them, any prediction based upon the anthropometry of the situation is likely to be of little moment. At the same time, the investigation of these general environmental influences demands just the same co-operation of many-sided effort and development of team enterprise. As a result of the stimulus of a world-wide war, for example, much more detailed information is now available about the precise effects of extremes of climate, and, a matter of special importance, of how to counteract, change and direct these, particularly by nutritional agencies. By brilliant scientific discovery, the effects upon group behaviour of immediate economic resources, of lines of transport, and in consequence of the size and trends of populations, have been vastly altered. The discoveries are in part physical and chemical and in part biological. Very often again, they have a strong medical interest. In this sphere also, therefore, a wide development of team-work is needed, so that the best methods may be applied to collect the most reliable and relevant data, and at the same time the significance of the data for an understanding of group reactions may be kept in view.

The story remains unaltered if we turn to the field of 'material culture'. Nothing has changed more rapidly or radically all over the world in recent times than material culture. Nothing has altered the ordinary everyday life of people, for good or ill, more profoundly than rapidly following applications of natural knowledge.

I think that, without giving up its long-established habits of studying very early developments of applied natural science, it is time that the anthropological study of material culture made more serious attempts to understand how the later products in the same line are affecting the lives of men. The physicist, chemist, engineer and biologist are the modern social reformers, though they rarely set out to be, because it is their discoveries which are the most widely applied to produce the quickest results. To understand how science revolutionizes the day-to-day life of man in every region of the world, and to appreciate fully how this influence is likely to be still further extended, once more needs collaboration between the anthropologist and all other natural scientists.

Of all branches of anthropological investigation it will be readily understood that the one which must interest the psychologist most of all is that which has to do with a group's less tangible possessions, with its institutions and their functions, with its customs, beliefs, trends and ideals. We may know all that can be known about levels and distribution of human capacities, about the influence of material culture, and still we shall only imperfectly understand, or be able to foretell, what changes will befall a group, and whether they will be transitory or permanent, until we can know the pattern of psychological possessions into which they must fit. To know this I think the psychologist and the anthropologist, to the great gain of both, must come more closely together than they have ever yet done. The last ten years or so have been a period of intense activity on the part of psychologists all over the world who have been interested in the social aspects of their science. They have invented and applied all kinds of special methods for the collection of evidence of a reliable nature about social attitudes, beliefs, opinions and the like. They have tried to find what forms of question, and what conditions of their application, can be most trusted. We now have an almost bewildering variety of possible lines of approach. There are questionnaires, with many special devices for getting representative samples of replies. There are interest inventories, opinion and assessment scales for rating social attitudes and activities. There are diverse forms of special interview. Prof. K. Lewin and his students, and many others as well, have begun to try experiments with partially controlled social groups. Elsewhere the beginning of a direct experimental attack has been made upon the problem of how, in fact, people anywhere do actually think about social questions. Efforts have been made, though these have usually been anything but sympathetic to psychology, to develop particular ways of observing mass behaviour and mass opinions. Still further removed from any official psychological countenance or free participation have been the tremendous and disturbing attempts to force public opinion and action by organized propaganda. The methods exhibit every degree of control, partial control and complete uncontrol. Almost every one of them has been used to point to conclusions, which have frequently been stated with exasperating dogmatism, and are of a kind that any anthropologist, who usually has a very much wider knowledge of comparative history, can treat with legitimate derision.

Yet derision is only rarely along the way of progress. The methods are here. They will be used. Indeed it is true to say that under the stimulus of a war which has made it necessary to plan for controlled behaviour in very large populations, those people, unfortunately fewer than they might be, who want plans to rest on evidence have turned more to the eager empiricism of the psychologist than to the more widely based and perhaps more dispassionate judgment of the anthropologist. Here then, in the study of social culture, let us work to forge a link, closer than ever before, between these two sciences.

Wherever we turn now we find scientific specialists with methods of ever-increasing accuracy for the establishment of knowledge about the great forces of Nature and their impact upon human kind. It is not surprising if sometimes those who follow this path allow the very intensity of their search and the demonstrable accuracy of their results to tempt them to premature generalizations which anthropologists, with a fairer knowledge of the wide sweep of history, and the enormous divergencies in and of human social groups, can reshape to better purpose.

In this rapid survey I have tried to show that the future for an anthropology which will understand and perhaps help to guide the destinies of man lies in a closer and more friendly relationship with all the special sciences, and particularly with all biological studies. The meticulous and attested knowledge we now must have. There is no escaping from that. Many men will play many parts, each branch of learning maintaining and increasing its integrity while yielding up its isolation.

I have suggested that the study of the distribution of fundamental human activities, of those factors which I have included under general environmental conditions, and of the impact of modern developments

of material culture, are all needed in order that we may reasonably estimate, in a rather abstract manner, what kinds of change could occur, or could be planned to occur, in specific groups, as a result of contact. But if these abstract possibilities are to be given any concrete status, they have to be considered in the light of studies belonging properly to social anthropology.

Let me use what may appear to be a somewhat trivial illustration. The people of Great Britain have recently received many invitations—if such they may be called—to change their food habits. On the whole, they seem to have done this with astonishing ease and success, when they have been left to decide how to do it for themselves. I do not know, but I suspect, that if a survey were made it would be found that, under these conditions, while food content has become much more uniform, meal-timing exhibits just as much diversity from one section to another of the population as it ever had. But there are large sections of the public for whom both the content and the timing of principal meals are prescribed pretty rigidly, and naturally the content is, or so it is alleged, determined chiefly by biochemical considerations in relation to economic possibilities, and the timing by industrial ones. Every anthropologist knows that food habits are ticklish things, and that whereas some communities change them with astonishing readiness, others resent and resist change just as naturally. I have no inside knowledge, but for what it is worth my own observation and information lead me to believe that if anybody liked to look into the matter he would find that often, when a noble meal of roast beef, potatoes, cabbage and the like is provided, a substantial proportion of the population for whom it is designed would be found sitting about in or out of their canteen, eating food obtained from their own retailers, and prepared in their own homes. If an anthropologist were asked about this, I think he would say, "First let me carry out a rapid survey of the food habits and their timing of these people, of their regularity and permanence". Then, perhaps, some scheme could be achieved which would satisfy the nutritionist, the economist, the industrialist, the Government officer, the anthropologist, and, most important of all, the people who must eat what is provided when it is ready. For all I know, this may have been done, but it does not appear to have been done on any considerable scale. I wonder why?

The main reason may be that there is as yet no general recognition of the fact that the speed, permanence and harmony with which any change of culture can be effected, whether it is planned or achieved without any deliberate planning, depend more upon how it is related to what I have called the group's 'psychological possessions' than upon anything else.

If we are to tackle the difficult and intricate problems of what changes are most likely to happen when different cultures meet, we must have some fairly definite guiding ideas. I suggest that a primary aim now should be to search for methods which will enable us to say with some certainty what are the hard' and what are the 'soft' points of group or sectional culture. The 'hard' points are those which will resist change, the 'soft' points those which will readily yield and open the way to peaceful reform.

To determine what is now called 'culture pattern', even when this can be done with wide assent, is not enough. A pattern is too independent of its detail, which may change almost indefinitely, at least within wide limits, leaving it recognizably the same. But in the case of culture it is the detail, quite as much as its relation to other details, which presents the obstacle or offers the opportunity.

First, very obvious and prominent differentiating points of contrasting cultures seem to be more often 'hard' than not. But just because they stick out and are possessed by one side only, they are often, especially by the reformer in a hurry, considered to be mere unimportant detail. It is not a bad rule to avoid hitting first and openly at manifestly differentiating points.

Secondly, if one of the four main lines of approach which I have discussed suggests that a specific change may readily occur as a result of contact, it is very tempting to expect, or even to plan, for such change. But this is always misleading evidence. For example, we may demonstrate a reasonable level and a wide dispersion of mechanical abilities in a community and at once set up a system of training suitable to modern highly mechanized industrial life. But if economic, political and social influences are adverse, this will only encounter in the end the hardest of all 'hard' points of culture. For it will set lots of people along some path of purpose and then stop all but the lucky few from reaching the goal. Many a partially thought-out scheme of education has foundered on this rock.

Thirdly, although the pattern concept is not by itself enough, it does seem true to say that the hardness or softness of cultural detail does depend on their 'lines of intercommunication' within the community; and it may be hazarded that detail is the more likely to change in proportion as it has some tangible expression which is dissociated from a group's psychological possessions, and less likely in proportion as it has little or no expression in the material side of culture.

To these tentative suggestions I now wish, though in no dogmatic frame of mind, to add one or two more. The social anthropologist who sets out to see methods for deciding hard and soft points in particular cultures is almost at once brought up against historical problems. The psychological expressions of culture usually, maybe always, have roots deep down into the past. How deep must we dig?

In the strange period of interlude between the two great Wars, psychology has been overrun by the view that everything that happens in human life is determined in and by the remote past. A rapid series of developments are pictured in early infancy, and after that, childhood, adolescence, the prime of life and old age merely succeed in donning a tremendous variety of disguises. Since the disguises are infinite in number, though often stereotyped in character, and all represent the same rather unpleasant pattern which is considered to be fixed before and soon after birth, this is one form, very extreme, of the explanation by culture pattern.

Anthropology has, I believe happily and honourably, escaped the greatest and gloomiest extravagances of this view. But not entirely. There are those who see in every group activity nothing but a disguised repetition of motives, impulses and events first played out in some long-gone cradle of mankind. The present and the future of all group development are tied to an unchanging past, and the apparent novelty of their forms is only an illusion. Explanation is a one-way traffic.

I wish to enter a very strong plea for the perfectly

naïve study of trends and ideals in social culture. I believe that if these are taken at their face value, and not merely interpreted in terms of archaic symbols and imaginative social origins, they will reveal, perhaps more readily than anything else, the soft and yielding points of any culture. In one way and another the study of man seems to have come into a period in which it is fashionable to treat trends and ideals with suspicion, and the more noble they may appear the more they are suspected. They are treated as tricks obscuring some unchanging struggle between primitive social instincts. It is time to call a halt to all this. There is no great difficulty and I think no great honour in showing that the trends and ideals by which modern social groups are organized have grown out of sorry beginnings. They are none the less achievements, often proud achievements, and if they are considered very simply, as any man of honest common sense will treat them, they can be seen as the pathfinders lighting the way to a knowledge of how cultures that meet will most powerfully interact.

There is another question the answer to which, it seems to me, anthropology, with its wide and minute study of comparative social history, can seek with more promise than almost any other branch of knowledge. This is the question, supremely important at the present phase of human affairs, of the time that may be expected to elapse before changes brought about through social contact can become established. Everybody must have noticed that it seems a lot easier to say what changes are likely to happen when two groups meet than it is to say when they will occur. This may be because, as many people think, the problem is insoluble, except by guesswork, or it may be, as I prefer to think, because it has rarely, if ever, been intensively studied by a combination of experimental and comparative methods and with a full appreciation of the immense influence of modern scientific invention and educational practice.

From the experimental field proper comes at least one glimmer of promise. Innumerable studies have been made of learning processes in animals and man. It is true that in most of these the balance of attention has been towards what is learned rather than towards the time of assimilation and establishment. But times have been plotted with great accuracy, and in the last few years it has become apparent that it *is* possible to state with reasonable accuracy how long it will take many new processes to be established, not only in the individual, but also in the group. Always, I think, the time is longer than the natural optimism of the innovator would like. Both the experiments and their applications have concerned selected groups alone, and so we are very far still from being able to apply the knowledge gained to the unselected and very diverse populations most often affected by culture contacts. But one thing has become very clear. Whenever the new process has to be exploited by a group, working as a group, the material and social possessions of that group, as they are when the process is introduced, must be considered. I do not think it is foolish to assert that an intensive comparative anthropological research, backed by a judicious use of experiment, could begin to predict with greater accuracy the timing of social change.

More: we know now that, with selected groups, it is possible to use methods to accelerate the establishment of the new and the discarding of the old. Why should the social anthropologist not look, in his field observations, for the ways in which these methods work in the unselected social community? It is not impossible.

Most people believe, and it is probably true, that the quickening of the means of communication and the enhanced control of natural resources which modern science has made possible have greatly accelerated the rate of change brought about by culture contact. It is an unevenly distributed acceleration, much more apparent in the fields of material culture than elsewhere. It may produce a false and a dangerous optimism—indeed, I think it has already done this—which may work havoc in the post-war world, unless the timing of the changes which one community can introduce into another is studied as scientifically as are the most favourable points of entry of such innovations.

One further consideration. It is not uncommon to find some feature of encroaching culture, coming from outside, apparently received into a group, and even given an enthusiastic welcome; but within a short time it has lost its place. Either it has gone as if it had never been, or it has changed into a form so identified with some pre-existing group of elements that it has lost all its integrity. Finding points of favourable entry is necessary, but it is not the same thing as discovering means of ensuring permanence. This is a task possible only for the anthropological team working in the field. I must confess that my field anthropological experience is lamentably slight, and it is with apologies that I use a case which came within my own attention.

However, I did once arrive at a fairly remote African group at a time of minor crisis. Certain practices, popularly denominated "witchcraft", had just been, for admirable reasons, blankly and with penalties prohibited. They were 'hard' points of culture and the chief effect was to drive them underground. When I arrived certain men, called "witch-doctors" by all the European inhabitants, were suffering periods of enforced inactivity. Naturally I looked them up, and it seemed clear that one or two at least were men of superior intelligence and alertness of mind. As soon as good relations were established they talked freely, and although I was in the unsatisfactory position of having to use an interpreter, one thing impressed itself on me at the time. I tried as simply as possible to explain a little about our own practice of psychological medicine. Perhaps it was only my fancy, but I thought I was met by a quickness and sympathy of understanding and an interest not by any means very common yet in the European world.

I think, if the possibilities of this had been more fully realized, the situation might have been better handled by the representatives of the European culture, but I had no chance to experiment and so far as I know nobody has tried this experiment since. I have, however, often looked for cases in which cultural change induced by contact has endured and at the same time maintained a certain integrity.

It does seem to me possible to collect a few general suggestions which may be used to guide the necessary further field research. If some detail is detached from one social setting and passes into another, it is exceedingly unlikely that it will survive for long in its original form. The most likely thing, if it persists at all, is for it to appear as a detail integral to the receptive culture. There are cases of endurance in such circumstances but, though I cannot claim wide

knowledge, I know of none in which the detail exchanged acquires any functional importance in its new setting.

If items that are transferred are to endure in approximately their original form and function, they must be given a concrete expression—something that can be seen, or heard, or performed; and this is the more important the more unselected and diverse is their new social group. There appears to be an intimate relation between certain types of expression and certain classes of item, and I think that to clear up and formulate these should be a primary object of field study.

The permanence or transitoriness of changes induced by the contact of cultures is closely dependent upon the link between these changes and other material in both the transmitting and the receiving groups. In other words, there is much truth in the view that culture moves in blocks. But very little is known about either the nature of the links required or about how they work. Nothing but directed research in the field can make these clear.

Finally, I suspect very strongly that no group can influence another permanently, except by establishing very friendly working relationships with a group which already possesses some social prestige within the receptive community, and the prestige of which will manifestly increase if it accepts and gets, to begin with, something like a 'corner' in the incoming reforms.

How do I picture an anthropology with a wider understanding and a greater potential power of guidance of the destinies of man? Certainly I do not see anthropologists as administrators, or administrators as anthropologists. The basic need is for the further development of anthropological research and teaching. If these grow as I see them, they will themselves constitute a co-operative effort in which many interests will combine. Perhaps in this way the immediate future of anthropology may become a mirror of the future of the wider world of mankind.

BLOOD PIGMENTS AND RELATED SUBSTANCES

A MEETING of the Biochemical Society held on November 13 was devoted to papers and discussion on "The Tetrapyrrolic Pigments".

Prof. D. Keilin gave an introductory survey of the properties and functions of natural tetrapyrrolic pigments. The iron derivatives of porphyrins, or hæmatins, form the active or prosthetic groups of many biologically important substances: hæmoglobins, cytochromes, catalase and peroxidase, which play fundamental parts in oxygen transport and cellular oxidations. The iron atom of hæmatin lies within the flat tetrapyrrolic ring system united by four covalencies to the pyrrol nitrogen atoms, while the remaining two valencies lie above and below the ring.

The porphyrins are highly fluorescent in ultraviolet light and show sharp absorption spectra. Although they combine with many metals, only the iron derivatives combine with proteins forming intracellular catalysts. The proteins are not colloidal carriers but integral parts of the molecule, and various proteins can combine with the same hæmatin to give catalysts of widely differing properties. The sharp absorption spectra of intracellular hæmatin compounds, particularly of the cytochromes, make possible the detailed study of cellular respiration by spectroscopic examination. All aerobic cells can synthesize the porphyrin nucleus and build up specific hæmatin catalysts. Anaerobic bacteria are devoid of hæmatin. A few exceptions to this rule are aerobes normally living in presence of hæmoglobin, for example, *Hæmophilus influenza* and *H. canis*. Cultures of these organisms need the addition of protohæmatin or protoporphyrin as a growth-factor.

The work of Pauling and Coryell on the iron-porphyrin linkage divides hæmatin derivatives into two groups; in one the linkages are covalent and in the other mainly ionic. Oxyhæmoglobin belongs to the former and hæmoglobin to the latter—an unexpected result which can only be explained by a fundamental electronic re-arrangement within the oxygen molecule when it combines with hæmoglobin.

The facile oxidative degradation of hæmatin *in vivo* to bile pigments, involving the opening of the porphyrin ring to a straight-chain tetrapyrrol, is in strange contrast to the great stability of porphyrins over millions of years in bituminous oils and coproliths.

Prof. H. Munro Fox dealt with the varieties of hæmoglobin. All hæmoglobins contain the same hæmatin nucleus, but the globin varies with the species and even within the species. Hæmoglobins of some invertebrates (erythrocruorins) differ from those of vertebrates in that they show high molecular weight, low iso-electric point and markedly different amino-acid analysis. Hæmoglobins of animals differ in many ways; for example, in spectra and in oxygen affinity. In the case of rabbits, spectrum differences have been observed among individuals. These differences must depend upon variations in globin structure, as also must the antigenic properties. Sir Joseph Barcroft's work on fœtal respiration has demonstrated the vital higher oxygen affinity of fœtal over maternal hæmoglobin.

The role of hæmoglobin in invertebrates seems less vital. Not only is its occurrence rare and very spasmodic, but also some species such as Chironomus can survive gassing with carbon monoxide. The respiration of this worm is only affected by carbon monoxide at very low oxygen pressures, when presumably the hæmoglobin comes into play as a carrier. A remarkable case of hæmoglobin increase in response to oxygen deficiency is that of Daphnia, which will change in a few days from bright pink when oxygen is deficient to colourless in well-aerated water, and vice versa.

The question of the formation and maintenance of hæmoglobin in invertebrates came up for discussion. In vertebrates the bone marrow controls hæmopoiesis, and the hæmoglobin is maintained in the ferrous state by specific intracorpuscular reactions. It is difficult to propose any corresponding mechanisms in invertebrates.

The function of tetrapyrrolic pigments in plants was reviewed by Dr. R. Hill. The fluorescence of porphyrins is decreased on combination with metals except in the case of the magnesium derivatives, and it is therefore understandable that chlorophylls, as photosynthetic agents, are magnesium porphyrin compounds.

Besides chlorophylls *a* and *b* in the ratio 3 : 1, a third derivative, protochlorophyll, with two hydrogens less in the porphyrin ring, may occur in higher plants. A fourth member of this class, chlorofucin.

occurs in diatoms and brown algæ. The red, blue and green algæ all contain chlorophyll *a* together with varying amounts of two fluorescent bile-pigment protein complexes, phycoerythrin and phycocyan. Many algæ show the property of chromo-adaptation and, when grown under coloured light, may assume the complementary colour.

The respiration of plants is catalysed by the same types of tetrapyrrolic compounds as are present in animal tissues. A plant extract has been obtained which shows the same cytochrome spectrum as that of baker's yeast or washed muscle tissue and will oxidize *p*-phenylenediamine and succinate. The oxidation and reduction of cytochromes can be observed spectroscopically in plant tissues. Two other specifically plant cytochromes have been isolated but their function has not been established.

In subsequent discussions Prof. Keilin described experiments proving that the cytochrome oxidase system and not the polyphenol oxidase is responsible for the bulk of plant respiration. The evidence was based on the effect of carbon monoxide on respiration. With the former enzyme the effect of carbon monoxide is sensitive to light; with the latter it is not.

The problem of the constitution of catalase was considered by Dr. E. F. Hartree in two ways: its close analogy with methæmoglobin, and the significance of the bile pigment derivatives normally found in the highly purified enzyme. The close analogy of methæmoglobin with peroxidase and catalase is apparent from colour and absorption spectra, and also from reactions with respiratory inhibitors such as cyanide, azide and sulphide. The spectrum changes obtained on addition of these inhibitors, and also of hydrogen peroxide and organic peroxides, show that catalase contains hæmatin, with trivalent iron, combined with a specific protein.

The isolation of biliverdin from catalase on treatment with acid acetone, together with a study of the hæmochromogens obtained from catalase after the addition of pyridine, indicate the presence of a bile pigment–iron–protein complex in catalases which appear homogeneous by physical criteria. Although it was at first accepted that the catalase molecule contains one bile pigment grouping and three hæmatins, it was later proved that the bile pigment plays no part in the activity of the enzyme and is not therefore built into the molecule during synthesis. The bulk of the evidence suggests that the bile pigment groups are the result of oxidative degradation of catalase hæmatins during normal metabolism, and are not formed during the processes of extraction and analysis of the enzyme preparations.

The findings of Keilin and Hartree on the ability of catalase to promote an oxidation of certain substances by the 'active' hydrogen peroxide formed during certain enzymic oxidations were brought forward to support a theory of catalase degradation *in vivo*. It was suggested that such a coupled oxidation of catalase occurs in the liver, which produces hydrogen peroxide during certain oxidation reactions. In this way the facile oxidation of catalase in the liver can be reconciled with its resistance to degradation by treatment with high concentrations of hydrogen peroxide. This question of an active or nascent form of hydrogen peroxide was taken up in the ensuing discussion, when an example of a similarly active form from an inorganic source (decomposition of barium peroxide) was cited.

Dr. J. R. P. O'Brien's paper reviewed the present state of our knowledge of the hæmoglobin molecule based on physico-chemical and X-ray measurements, and the synthesis and breakdown of hæmoglobin; processes dependent on the activity of the bone marrow and the liver.

The theory that globin is attached to iron via iminazol groups finds support in *p*K measurements of iminazols, but there is no evidence that the iminazol ring of histidine is involved. Histidine is found in all hæm proteins, consequently the unique globin-hæm linkage conferring the property of oxygenation is more likely to depend upon some group peculiar to globin. In this connexion it must be borne in mind that less than 70 per cent of the globin molecule has been accounted for by amino-acid analysis.

Porphyrin production can be maintained under adverse conditions, though the iron and globin supplies for hæmoglobin synthesis depend largely on dietary supply. The mode of synthesis of hæmoglobin is unknown, though further knowledge of the structure of the molecule as, for example, is available from the X-ray measurements of Perutz, may shed light on this problem. The first stage in hæmoglobin catabolism appears to be the 'easily splittable iron' of Barkan, which accounts for about 5 per cent of erythrocytic iron. The process then passes via biliverdin and bilirubin to urobilin. The latter is partly excreted as such and partly after further breakdown to pyrromethines.

The beneficial effect of ascorbic acid in T.N.T. methæmoglobinuria indicates the necessity for a reducing agent within the erythrocyte to maintain hæmoglobin in the ferrous state. This mechanism may be intimately connected with glucose metabolism.

In the discussion that followed, the absence of the Soret, or γ, band in the absorption spectrum of red-cell suspensions was considered. Prof. Keilin brought forward evidence that this is a purely optical phenomenon and cannot be accounted for by the theory of a hæmoglobin-stromatin complex. Thus the band is absent from a suspension of hæmoglobin droplets in oil.

Dr. C. Rimington dealt in detail with the pathological conditions in which large quantities of uro- and coproporphyrins are formed and excreted. Free porphyrins occur normally in small quantities in plants, bacteria, yeasts, and many animal tissues. Protoporphyrin does not appear in pathological conditions, while the uro- and coproporphyrins each appear in two isomeric forms (Series I and III of Fischer). It is not possible to regard one as normal and one as pathological. While the coproporphyrins are normal constituents of urine and fæces, the presence of uroporphyrins must be regarded as pathological, although certain squirrels excrete large quantities. The most striking instance of uroporphyrin production is in the *turacos*; these African birds have wing feathers coloured bright red by copper-uroporphyrin III.

The porphyrinopathies may be divided into three groups: (1) *Porphyrinuria* may be brought about in any person by certain factors; for example, hepatic dysfunction, lead or sulphonal poisoning. Urinary coproporphyrin is greatly increased. (2) *Porphyria congenita* is a rare condition present from birth and probably hereditary. Copro- and uroporphyrins are excreted in large quantities in the urine and fæces, and the teeth and bones are brown. The photoactive porphyrins produce considerable photosen-

sitization. A similar disease is known in cattle. (3) *Porphyria acuta* appears later in life. There is no bone pigmentation or photosensitivity, but much porphyrin is excreted during attacks. Other sets of symptoms may predominate and the disease is usually fatal.

Porphyrins are to be regarded as products of deranged hæmoglobin synthesis rather than as degradation products. Further knowledge of hæmoglobin synthesis will no doubt help to elucidate the problems of the abnormal production of porphyrins.

This meeting was very successful, but could have been improved by the allotment of more time for discussion of the many interesting points raised by each contributor. Sir Joseph Barcroft, in his concluding remarks, expressed the hope that the proceedings would be published *in extenso* to allow a more careful study of a valuable contribution to our knowledge of the tetrapyrrolic pigments.

OBITUARY

Dr. W. H. Hatfield, F.R.S.

DR. WILLIAM HERBERT HATFIELD, director of the Brown-Firth Research Laboratories, Sheffield, who died on October 16 after a very short illness, had played a leading part in the development of metallurgical research in Great Britain, besides holding an important position in the steel industry. He was born in Sheffield on April 10, 1882, and worked in the laboratory of Messrs. Henry Bessemer and Co., studying at the same time at University College, Sheffield, under Prof. J. O. Arnold.

Hatfield went to the firm of J. Crowley and Co. as metallurgist, and while there published his first original research, a study with Prof. A. McWilliam of the elimination of silicon in the acid open-hearth. A second joint paper on the same subject followed in 1904. He was awarded the Mappin Medal and also a Carnegie Scholarship, which led to the publication in 1906 of a memoir on the forms of carbon in cast iron. In 1909 he developed this subject further, and showed that, contrary to the widely accepted statements of Wüst, it was not necessary that carbon should be precipitated as temper graphite before being oxidized in the production of malleable castings. The experiments, which were well designed to settle the point, were conducted in the works, the microscopical studies being made in Prof. Arnold's department, now a faculty of the University. These investigations were next expanded into a book.

In 1916 Hatfield succeeded Mr. Harry Brearley as director of the Brown-Firth Laboratories, and gathered round him a technical staff. Brearley had in 1912 invented the first 'stainless' steel, a high-chromium steel which when correctly heat-treated was highly resistant to corrosion, and found special application in cutlery. To administer the patent rights the Firth-Brearley Syndicate was formed. In the meantime, Messrs. Krupp of Essen had covered by patents a wide range of steels containing both nickel and chromium, with the primary object of using them for high temperatures, although their resistance to corrosion at atmospheric temperatures had also been noted. Hatfield made a thorough study of these steels, and selected 18 per cent chromium and 8 per cent nickel as giving the most useful results when suitably made and treated. This "18 : 8", to which Firths gave the name of 'Staybrite', became the most widely used of this series of alloys, and its success was largely due to the energetic efforts of Hatfield. He made a detailed study of the properties of the austenitic stainless steels, especially of the intercrystalline corrosion to which they were liable under certain conditions, as when welded. This difficulty was overcome partly by keeping the carbon content low and partly by adding carbide-forming elements, such as titanium. The activities of his own firm, of which he became a director, led him to give much attention to steels for guns, aircraft and marine forgings, and his later researches dealt mainly with alloy steels, especially with mechanical properties, behaviour at high temperatures, resistance to creep, and corrosion.

As a result of experiences in the War of 1914–18, certain research committees were set up by the Iron and Steel Institute, but after the first enthusiasm had passed there was a danger that their ambitious programmes might be dropped, and it was owing to Hatfield that a definite scheme was put in hand in 1924 with the object of determining the nature and causes of heterogeneity in steel ingots. This Ingots Committee, of which he was chairman, was followed by similar committees on corrosion, alloy steels, and steel castings. These and other committees and sub-committees were co-ordinated under the Iron and Steel Industrial Research Council. There is no doubt that this organization, which has been and still is responsible for co-operative research in the steel industry of Great Britain on a large scale, owes its success very largely to Hatfield, who had the art of persuading manufacturers to co-operate by pooling information, contributing money and materials, and undertaking experiments in their works, while universities and public institutions such as the National Physical Laboratory were effectively brought into the scheme.

The present War brought Hatfield new and heavy tasks. As chairman of the Technical Advisory Committee on Alloy Steels, he was instrumental in reducing to a small number the great mass of steel specifications, thus simplifying the work of the steel maker and economizing the rarer metals. In the summer of the present year he was a member of an iron and steel mission to the United States, which he had visited once before in 1928, when he gave a series of lectures afterwards published in book form. The extra strain no doubt told on him, and although his health had seemed invulnerable, the end came rapidly.

Hatfield enjoyed controversy, and in committees could be deliberately provocative, but it was possible to differ strongly from him either on scientific matters or on questions of policy without any break of personal friendship, for he was incapable of bearing malice, and differences were soon healed. Sheffield, where most of the research committees usually met, will seem a different place without him, and he will be equally missed at the meetings of many technical societies. In 1907 he married Miss Edith Marian Seagrave, and he owed much during the stress of scientific and commercial work to the companionship and support of his wife.

Dr. Hatfield was elected a fellow of the Royal Society in 1935. He received the Bessemer Medal of the Iron and Steel Institute, of which he was a devoted member, in 1933, and became a vice-president in the following year. He founded the Sheffield Metallurgical Association, of which he was the first president, and held office in many other societies.

C. H. DESCH.

NEWS and VIEWS

Foundation for Educational Research

THE Foundation for Educational Research, recently set up in association with the University of London Institute of Education, owes its origin to an offer of 10,000 dollars from the Carnegie Corporation of New York. This was made to encourage a 'carry-over' of interest in research from the work done under the directorship of Sir Philip Hartog by the English Committee of the Carnegie International Examinations Enquiry. The conditions attached to the offer were that the money would be paid over as equal amounts were subscribed in England, and that the fund should be administered by the Institute of Education. A generous grant of £1,000 from the Leverhulme Trustees thus made the sum of £2,000 available. As soon as conditions permitted, the Institute constituted an advisory council, and this body urged a considerable expansion of the original scheme so as to provide for a period of at least five years of systematic work. This expansion is now being put into effect with good hopes of wide support. The intention is that the present organization shall merge itself into a permanent national organization as soon as that stage can be reached. The first piece of work to be undertaken is a programme of researches designed to arrive at trustworthy diagnostic techniques for the 'sorting' of the young adolescent population which will be necessary in carrying into effect the White Paper proposals for post-primary education in Great Britain.

University Grants Committee

THE Chancellor of the Exchequer has announced that the membership of the University Grants Committee has been increased from ten to fifteen. It is constituted as follows: Sir Walter Moberley (chairman), formerly vice-chancellor of the University of Manchester; Dr. E. A. Benians, Master of St. John's College, Cambridge; Prof. W. E. Collinson, professor of German in the University of Liverpool; Sir Charles Darwin, director of the National Physical Laboratory; Miss Margery Fry, formerly principal of Somerville College, Oxford; Sir Robert Greig, director of the London, Midland and Scottish Railway, member of the Carnegie Trust for the Universities of Scotland and of the Agricultural Research Council; Prof. A. V. Hill, Foulerton research professor of the Royal Society; Dr. P. D. Innes, chief education officer, Birmingham; Sir Frederic Kenyon, formerly director and principal librarian of the British Museum; Prof. P. S. Noble, regius professor of humanity, University of Aberdeen; Principal Andrew Robertson, recently professor of mechanical engineering, University of Bristol; Prof. E. J. Salisbury, director of the Royal Botanic Gardens, Kew; Dr. J. C. Spence, lecturer on diseases of children, University of Durham; Prof. R. H. Tawney, professor of economic history, University of London; Sir Henry Tizard, president of Magdalen College, Oxford.

University of Oslo

AT the seventh meeting of the Conference of Ministers of Education of the Allied Governments, held in London at the offices of the Board of Education on December 7, with Mr. R. A. Butler, M.P., in the chair, the following message of sympathy and encouragement, with which the Conference associated itself, was handed to the Norwegian Minister of Education:

"We in Great Britain have been deeply shocked to hear of the brutal action by the German Occupying Power in Norway against the students and teaching staff of Oslo University. We are well aware that the arrest and threatened deportation of the flower of Norway's youth are designed to crush Norwegian intellectual resistance and to strike at those reserves of trained minds, which will be so badly needed during the post-war reconstruction period. We have watched with pride and admiration the unarmed struggle of your Nation. We have seen how your people have used the rich resources of their cultural and educational tradition, which we so greatly respect, to resist every attack by their oppressors. Norway's intellectuals have stood firm against trickery and enticement, against brutality and reprisals. All those concerned with education in Britain will join in sending our sympathy to our colleagues in Norway and particularly to Norwegian students and teachers. We know that this latest attack will be as fruitless as any other of the Nazis' efforts to subjugate the Norwegian people. We are confident that it will recoil inexorably on the heads of its instigators. Once more the Nazis have shown their determination to suppress every vestige of freedom of thought. The example of the Oslo students and teachers will strengthen the resolution of all defenders of liberty throughout the world."

Council for the Promotion of Field Studies

As a result of a preliminary investigation carried out by Mr. F. H. C. Butler, a meeting convened by him was held on December 10 at the British Museum (Natural History) to inaugurate a Council for the Promotion of Field Studies. Attending this meeting were some thirty-five delegates appointed by universities of England and Wales, university colleges, scientific societies and institutions, including the National Trust and the Council for the Preservation of Rural England. Prof. F. E. Fritsch was in the chair. Mr. Butler made a general statement of the aims of the proposed Council. He had found, he said, very strong support for his view that the facilities for study and research in the field needed to be much improved; one of the main functions of the Council would be to establish and maintain hostels for field studies, under trained wardens, in various parts of the country. It seemed to be widely felt that the Council could fill a very important gap in our system of education both at the school and university level. His address was followed by a full and interesting discussion; the motion to form the Council was then put to the meeting and carried unanimously. The following were appointed as officers and members of the executive committee: Mr. F. H. C. Butler, Primrose Farm, Little Wilbraham, Cambridge, honorary secretary; Mr. C. C. Fagg, honorary treasurer; Prof. F. W. R. Brambell, Mr. M. C. Burkitt, Dr. A. R. Clapham, Dr. H. Godwin, Prof. W. T. Gordon, Mr. L. A. Harvey, Mr. O. D. Kendall, Mr. N. B. Kinnear, Prof. W. B. R. King, Mr. R. H. Kinvig, Prof. W. H. Pearsall, Mr. H. J. F. Smith, Prof. A. G. Tansley, Mr. R. R. Tomlinson, Prof. C. W. Wardlaw, Prof. C. M. Yonge. The Board of Education will be represented by Mr. F. H. B. Fox and the Scottish Education Department by Mr. J. W. Parker, who will act in an advisory capacity.

Controller-General of the Ministry of Fuel and Power: Dr. H. S. Houldsworth, K.C.

DR. H. S. HOULDSWORTH, K.C., who from January 1, 1944, becomes controller-general of the Ministry of Fuel and Power, graduated in science at the University of Leeds in 1911, taking first-class honours in physics as a student of the late Sir William Bragg. After some years of school-teaching and after the outbreak of war, he entered the Fuel Department of the University on the staff of Prof. J. W. Cobb, the regional deputy inspector of high explosives, visiting works for the sampling and testing of their products. In 1918 with the coming of peace he remained with Prof. Cobb in a newly created post as research assistant on refractory materials, working, and later lecturing, on that subject. In a period of seven years he was joint (or sole) author of a series of papers, mainly for the Ceramic Society, dealing with such matters as the thermal expansion of refractories and the transformations of silica, and although he entered on this work with no special knowledge of the subject, then little studied, he grappled with it effectively and in 1925 was awarded the D.Sc.

Meanwhile Dr. Houldsworth retained and developed an interest in public work in close association with Sir John (now Lord) Simon, the member of Parliament for Spen Valley, and with his encouragement read successfully for the Bar examinations and entered on a new career as barrister. Here he had no long waiting period, but was soon busy, particularly with the coal industry and its multitude of agreements and discussions of one kind and another, in which owners, miners, users and Government authorities were involved. His variety of experience with people differing so widely in training, position and outlook, combined with innate qualities to make him increasingly valued both for sanity of judgment and honesty of purpose. The same qualities have no doubt marked his tenure of office as regional controller of the Ministry of Fuel and Power for the North Eastern Division, to which he was called when the war effort for fuel economy came under Government organization. The extension of his responsibilities now announced will be widely welcomed, particularly by those who have known his work. Typical of his methods was the Yorkshire Fuel Efficiency Committee, for which he secured the effective collaboration of industrial, academic and official representatives and the willing assistance of trained men, in the drive for economy in the industrial uses of fuel.

Government Fuel Research in Great Britain

IN an address to the Institute of Fuel in Newcastle upon Tyne on December 13, Dr. A. Parker, director of fuel research of the Department of Scientific and Industrial Research, surveyed the activities of the Fuel Research Board. To-day, this State organization, with a staff of more than 250, includes the central Fuel Research Station, equipped not only for experiments in the laboratory, but also for experiments on a semi-commercial scale and on a full commercial scale. The full-scale units include plants for cleaning, drying and pulverizing coal, for the manufacture of fuel gases, hydrogen and coke, and there are full-size boilers of several kinds. Experimental work has also been undertaken in co-operation with industry. In addition to the Fuel Research Station, there are nine coal survey laboratories in various parts of England, Scotland and Wales which have been undertaking, in collaboration with the Geological Survey, a comprehensive survey of the qualities of the coal resources of Great Britain. This survey is now being put on a quantitative basis in co-operation with the Coal Commission and the Ministry of Fuel and Power. As a result of this survey, we already have much more information about our coal reserves and the coals on the market than there is about the coals in any other country. Referring to achievements of the fuel research organization, Dr. Parker stated that simple equipment has been developed for fitting to large industrial boilers, which not only greatly reduces the quantity of smoke from the boiler chimney but also increases the efficiency of the coal in raising steam, and work on transport producers using coal and coke in place of petrol for road vehicles, begun at the Fuel Research Station before the War, has led to the introduction of the Government Emergency Producer now in use on many road vehicles. Processes for the production of petrol and other oils and chemicals from coal have received considerable attention at the Fuel Research Station, and a great deal of information has been obtained from experimental work on the distillation of coal, hydrogenation of coal and of tar, and on synthetic methods of producing oils and chemicals from gases made from coal and coke.

Continuing, Dr. Parker said that if Great Britain is to maintain its position in industry, we must rapidly develop our scientific and industrial research in relation to coal and other fuels, in the widest national interest. There must also be a spirit of mutual help in research, involving friendly discussion and collaboration between the scientific men in universities, in Government establishments, industrial research associations, and other research organizations. In relation to fuel in Great Britain, a good beginning in this direction has already been made. The Department has set up a consultative conference on fuel research, which is attended by representatives of the Iron and Steel Industrial Research Council, the British Refractories Research Association, the British Electrical and Allied Industries Research Association, the British Coal Utilization Research Association, the British Hard Coke Research Association, and the Gas Research Board. In his concluding remarks, Dr. Parker issued a note of warning. He said that where there is a lack of the real appreciation of the conditions under which successful research is carried out, there is an impression that if large sums of money are provided for research, marvellous discoveries would follow as a matter of course. While adequate financial provision is naturally essential, it is not in itself enough. The primary requirement is men of the right training and outlook.

Commemoration of the Invention of the Barometer

AT the University of Toronto on October 19, two meetings were held to commemorate the invention of the barometer by Torricelli, three hundred years ago. Last spring, the Canadian Branch of the Royal Meteorological Society decided that this important scientific event should be fittingly commemorated, and invited the Royal Astronomical Society of Canada, the Royal Canadian Institute, and the University of Toronto to join with it in making the arrangements, which were entrusted to a committee under the chairmanship of Mr. W. E. K. Middleton. At the afternoon meeting held in the West Hall of the University College, Prof. C. A. Chant was chairman, and pres-

ented to the meeting delegates from the Royal Society of Canada, the American Meteorological Society and the History of Science Society. The first formal paper, entitled "Telescope, Microscope, and Barometer as a Point of Departure for the Natural Sciences", was delivered by Prof. Louis C. Karpinski, of the University of Michigan, president of the History of Science Society, who treated the discovery of the barometer as one phase, and an important one, of the scientific renaissance that took place in the sixteenth century. He was followed by Prof. G. S. Brett, of the University of Toronto, who dealt with the remarkable effect of the discovery on contemporary thought, particularly as it affected the relations between science and theology, and the ideas of the structure and properties of matter.

The evening meeting was held in the McLennan Laboratory of the University of Toronto, under the chairmanship of Dr. J. Patterson, controller of the Canadian Meteorological Service, who opened the proceedings by repeating the Toricellian experiment before a large audience. Mr. W. E. K. Middleton, of the Meteorological Office, then gave an illustrated lecture on the subsequent history of the barometer, showing many slides of interesting instruments developed throughout the past three hundred years. Finally, Prof. John Satterly, of the University of Toronto, presented a paper on the applications of the barometer in physics and chemistry, and emphasized the need for considerable precision when the barometer is used in physical research. It is hoped to publish these papers in the *Journal of the Royal Astronomical Society of Canada*.

The Chinese Medical Journal

THE reappearance of the *Chinese Medical Journal*, the publication of which, says the *Lancet* (559, Oct. 30, 1943), was suspended by the occupation by the Japanese of the Chinese Medical Association's offices, coincides with the publication of a book by one of the editors of the *Journal*, Dr. Szeming Sze, entitled "China's Health Problems". Dr. Sze, who was educated at an English public school, at the University of Cambridge and at St. Thomas's Hospital, is also general secretary of the Chinese Medical Association, which now has offices at Washington, the address of which is P.O. 6096. Reviewing Dr. Sze's book, the *British Medical Journal* (580, Nov. 6, 1943) indicates the magnitude of China's health problems. The morbidity-rate is 4 per cent of the population, which means that, in any one day, about 16 million people are ill in China. To treat these there are, in the whole country, 12,000 doctors and 38,000 hospital beds. The usual medical standards require that there should be at least 266,000 doctors and 2 million hospital beds. As things are, many Chinese people still rely exclusively on native methods of treatment. Anyone who is interested in one aspect of these should read the article on Chinese Anthelmintic Prescriptions from the Han period (about 217 A.D.) to the present time (1940) by C. S. Chao, in the *Chinese Medical Journal* (57, 251–289; 1940).

It is proposed to publish the *Chinese Medical Journal* quarterly from the United States until the end of the War, and at the same time to issue from Chungking a medical digest in the Chinese language. The other editor of the *Journal* is Dr. J. Heng Liu. The first issue of the newly published *Journal* includes accounts of typhus fever in Kunming and Shanghai, and articles on malaria, cholera and plague. The work of the Weishengshu Anti-epidemic Corps, which sends mobile units from Chungking all over free China, is described. It is stated that Japanese aeroplanes dropped parcels of grain and rags, containing plague-infected fleas, over Changteh in November 1941; a few days later bubonic plague broke out in the city. News is also given of various agencies and relief organizations now at work in China. The Henry Lester Institute at Shanghai is still active, but its director is now Japanese. The Peking Union Medical College and Hospital are, however, closed and their director, Dr. H. S. Houghton, has been interned.

Train Orders by Facsimile Telegraphy

FACSIMILE telegraphy is one of the devices recently called upon by the railways to help meet the unprecedented demands of to-day. It has many advantages over other forms of communication for several railway applications. For example, its inherent accuracy makes it an ideal method for the handling of train orders and once the order is prepared for transmission it need never again be copied manually. The possibility of transmission error is greatly reduced by the fact that the method can operate through extremely high levels of interference. Simplicity of operation and the ease with which duplicate copies may be secured are additional advantages. Automatic recorders, housed in small shacks along the right-of-way, are located at sidings, branches, crossings—wherever a train might be required to stop. Recorders may also be installed in small stations where telegraph service is not provided. An automatic transmitter, under control of the operator for the district, is arranged so that he may transmit orders to any of these recorders.

Since the recorders are entirely automatic, the order may be transmitted in advance of the arrival of the train. The circuit is arranged so that the transmitter may be set by the operator to send automatically as many copies of the order as are required by the various members of the train crew, and the orders are thus secured with a minimum of time and effort. The time and effort required of the operator are equally slight; he dials the desired recorder, sets an indicator to the desired number of copies, and drops the order into the machine. The messages simply roll out of the machine into a receptacle whether or not there is anyone present to receive them. A recorder readily adapted to such service was developed by the Western Union Telegraph Company for use in conjunction with automatic transmitters, and the equipment comprises what is probably the most completely automatic telegraph system yet devised. An article by J. H. Hackenberg (*Elec. Comm.*, 21, No. 2; 1943) describes and illustrates the new equipment and its mode of operation.

A South American Review of Newton's Work

IN a paper entitled "El Tricentenario De Newton", Mario Bunge examines five different aspects of Newton's work (Buenos Aires: Universidad Obrera Argentina Instituto Cientifico, Seminario De Filosofia, November 1942. Pp. 8). The first of these is his discovery and application of the infinitesimal calculus, a discovery which unfortunately caused some unpleasant feeling with Leibniz, though, as is pointed out, each represented a distinct school so that their contributions can be regarded as complementary.

Secondly, Newton was responsible for the introduction of the deductive method in the natural sciences and so rendered signal service to mankind as the founder of mathematical physics, which has been the basis of so much in science for two and a half centuries. Then, his rational mechanics had a profound influence for many generations. Newton's differential equations showed how the state of the universe to-day is the result of all its past history, and its future history could be determined by its present. This required a strict determinism which obsessed the minds of men of science for a long period, though in comparatively recent times there has been a strong reaction against it. His work on optics showed his ability as an experimental physicist. Newton's subordination of optics to mechanics, far from enhancing progress, was a principal cause of the lack of progress in optics during the eighteenth century. An ironical result of his experiments with diffraction and interference was the death-knell a century later of his corpuscular theory of light. Lastly, Newton's philosophical work must not be forgotten. Space and time were objective and independent of our perception of them, according to Newton, and were not *a priori* representations which served for the foundations of all external intuitions. Force, energy, mass, motion, as well as space and time, were all objective entities for Newton. His work must be considered a model of the systematic application of scientific method—a model of the power of reason to investigate the natural, controlling and ruling it, by placing it at the service of progress, material, cultural and moral, of humanity.

Earthquakes Recorded during September

THE U.S. Coast and Geodetic Survey has determined the epicentres of six earthquakes occurring between Sept. 5 and 20. The first was on Sept. 5 from lat. 0° long. 125° E., which is in the Molucca Passage east of the island of Celebes in the East Indies; time at origin, 8h. 34·8m. The second was on Sept. 6 from an epicentre lat. 53·2° S. long. 159·4° E., which is north-east of the Macquarie Islands, south-west of New Zealand; time at origin, 3h. 41·5m. The third was on Sept. 10 from an epicentre lat. 18·9° N. long. 67° W., which is near the north-west coast of Porto Rico in the West Indies, time at origin being 2h. 31·6m. The fourth was also on Sept. 10, from an epicentre near lat. 35·1° N. long. 133·3° E., which is in the Pacific Ocean west of California, time at origin being 8h. 36·9m. The fifth was on Sept. 11, from an epicentre near lat. 16½° S. long. 173° W., which is in the Pacific Ocean between Samoa and the Friendly Islands and east of Fiji. Time at origin was 19h. 34m. The sixth was on Sept. 20 from an epicentre near lat. 19½° N. long. 109° W., which is in the Pacific Ocean west of Mexico and north-east of Revilla Gigedo Island. Time at origin was 00h. 53·7m.

Earthquakes were registered at Kew on Sept. 5 at 08h. 49m. 11s. from an epicentre 12,000 km. distant; on Sept. 6 at 04h. 01m. 32s. from an epicentre 18,700 km. distant (maximum amplitude at Kew 440 μ); and on Sept. 10 at 08h. 49m. 32s. from an epicentre 9,560 km. distant (maximum amplitude 250 μ at Kew). All times are in Universal Time and interpretations and calculations are provisional.

On October 26 an earthquake was felt in San Francisco. Some telephones were put out of action, some windows broken and some articles jolted off shelves.

Announcements

THE title of professor of technical optics in the University of London has been conferred on Dr. L. C. Martin in respect of the post held by him at the Imperial College of Science and Technology.

THE University of Oxford has accepted an offer from the Lord Nuffield Provincial Hospitals Trust of £8,000 a year for research in plastic surgery and for training in that branch of surgery.

DURING 1943 the Royal Society of South Africa elected the following fellows: John G. Rose, formerly Government analyst and chief chemist to the S.A. Railways and Harbours, Cape Town, for his valuable applications of chemistry in the field of engineering; and Hillel A. Shapiro, assistant Government pathologist, Cape Town, for his work on experimental physiology and malnutrition. The Abbé Henri E. P. Breuil, the distinguished archæologist, at present attached to the University of the Witwatersrand, Johannesburg, has been elected an honorary fellow of the Society.

THE Charles L. Mayer Award for 1943 will be made by the National Science Fund of the U.S. National Academy of Sciences for an outstanding contribution to present-day knowledge of factors affecting the growth of animal cells, with particular reference to human cancer. In addition, the advisory committee requests recommendations from scientific men of persons whose present work is in this field and who are achieving outstanding results. The closing date for the receipt of manuscripts and published articles is January 15, 1944; they should be sent to the National Science Fund of the National Academy of Sciences, 515 Madison Avenue, New York 22, N.Y.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, London, W.C.1, have issued a price list of certain German publications which are being reproduced in the United States by photo-offset process under authorization of the Alien Property Custodian in Washington. It includes books on mathematics, physics and chemistry, mainly published during the period 1930–40; among the titles are many standard works of references, as well as recent technical books. Messrs. Lewis are accepting orders, but anticipate a delay of three months in obtaining copies.

SIX popular lectures on astronomy have been arranged by the Royal Astronomical Society and the British Astronomical Association, and are being given on Fridays at the Royal Astronomical Society's rooms in Burlington House, Piccadilly, London, W.1, for members of the British and Allied Forces. The first was given on December 3 by Sir James Jeans on "Photographic Astronomy". On December 17 Prof. W. M. Smart is speaking on "The Origin of the Earth". Succeeding lectures will be given on January 7, by Mr. B. M. Peek, on "The Planets and Planetary Observations"; on January 21, by Prof. H. Dingle, on "The Movements of the Stars"; on February 4, by Mr. Will T. Hay, on "Life on other Planets"; and on February 18, by Mr. F. J. Hargreaves, on "The Determination of Stellar Distances". The lectures begin at 6.30 p.m. Admission is free by tickets obtainable from Service Organizations or from the Assistant Secretary, Royal Astronomical Society, Burlington House, Piccadilly, London, W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Non-Solar Planetary Systems

IN discussing the significance of the two planet-like bodies which are now supposed to revolve around 61 Cygni and 70 Ophiuchi, Mr. Sen writes[1] that "we find that there can be at most two planetary systems in the galactic system, on Jeans's theory". If the true number were two, or anything like two, it would, of course, be out of the question to suppose that there could be three planetary systems so near to us in space. But I do not think that the true number is anywhere near to two; in a recent letter in NATURE[2], I calculated that something like one star in six might well be accompanied by planets, in which case the number of galactic planetary systems would not be two, but some tens of thousands of millions. There is no reason why 61 Cygni and 70 Ophiuchi should not be two out of these millions of systems, so that I think that Mr. Sen's argument against my tidal theory fails.

Mr. Sen refers with approval to Banerji's modification of this theory. This makes the original sun a Cepheid which had its oscillatory instability increased by the gravitational attraction of a passing star. But a passing star cannot increase the instability of a Cepheid appreciably unless it comes very near; and as a very near approach can do all that is needed with *any* star, why introduce the added complication of supposing the star to be a Cepheid? Judging by their luminosity, all Cepheids are much more massive than the sun or 61 Cygni or 70 Ophiuchi, although, of course, this may not have been so in the remote past.

I cannot see that the discovery of the new planet-like bodies affects the present tidal theory in any way, except that, if we interpret them as true planets, they may perhaps give some slight support to my calculation[3] as to the frequency of planetary systems in space.

J. H. JEANS.

Lodge Hill House,
Westbury-sub-Mendip, Wells.

[1] NATURE, **152**, 600 (1943).
[2] NATURE, **149**, 695 (1942).
[3] *loc. cit.*

Non-Solar Planets and the Origin of the Solar System

THE discovery of two non-solar planets[1-3] makes it possible to check theories of the origin of the solar system.

Some time ago I pointed out that the motion of ionized matter even at the distance of the planets from the sun is affected very much more by the sun's general magnetic field than by solar gravitation, and that consequently this magnetic field may have been of fundamental importance at the genesis of the solar system[4]. A theory was put forward according to which the planets were formed of matter falling in from interstellar space towards the sun, and stopped by the action of the sun's magnetic field as soon as it became ionized by the heating due to gravitation. The theory requires that the main part of the matter become accumulated at that distance r from the sun (mass $= M_\odot$) where the gravitational energy equals the ionization energy eV_{ion}. Thus we have:

$$\frac{M_\odot m}{r} = eV_{\text{ion}}, \qquad (1)$$

where m is the mean atomic weight of the gas. The distance r equals the orbital radius of Jupiter if $V_{\text{ion}} = 12$ volts and $m = 7$ (or, through a certain correction, $m = 10$), which values are quite reasonable.

When Jupiter's mass is substituted for the solar mass in (1), r becomes equal to the distance of the large Jovian satellites, which indicates that they may have been generated in the same way as the planets. The structure of the Saturnian system also is consistent with the theory.

The invading matter probably originated from a gas cloud once surrounding the sun. If other stars have been surrounded by clouds of the same mean atomic weight, they are likely to possess similar planetary systems, the dimensions of which are proportional to the masses of the stars. Thus the 'Jupiter' of a star with the mass M (sun = 1) will have the orbital radius

$$r = 5{\cdot}2\,M \text{ astron. units.}$$

Observations have not determined to which components of the double stars the newly discovered non-solar planets belong. My theory requires that for a given cloud density the larger component shall have the more massive planetary system. As the components of 61 Cygni are almost equal, the largest planets of each of them should have almost the same masses and periods, so that the observed disturbance is due to both of them. For 70 Ophiuchi a planet of the larger component ought to produce the greatest effect. Thus we find:

Star	Mass	Distance of planet	
		Theory	Obs.
61 Cygni[2]	0·56	2·9	2·4
70 Ophiuchi[3]	1·1	5·7	6·8

The agreement indicates that these non-solar planets may have been formed in the same way as our planetary system.

The theory makes it probable that all stars are surrounded by planetary systems (more or less massive) of the same structure as ours. Planets corresponding to Jupiter will have the period

$$T = 11{\cdot}9\,M \text{ years.}$$

It may be worth while to look for disturbances with such periods.

H. ALFVÉN.

Kungl. Tekniska Högskolan,
Stockholm. Nov. 3.

[1] Hunter, A., NATURE, **152**, 66 (1943).
[2] Strand, K. A., *Pub. Ast. Soc. Pac.*, **55**, 29 (1943).
[3] Reuyl, D., and Holmberg, E., *Astrophys. J.*, **97**, 41 (1943).
[4] Alfvén, H., "On the Cosmogony of the Solar System", I and II, *Stockholms Observ. Ann.*, **14**, No. 2 (1942) and No. 3 (1943).

Mutation and the Rhesus Reaction

RECENT announcements by Race, Taylor[1,2] and their collaborators in these columns, and by Wiener and Landsteiner[3], elsewhere, are of peculiar interest in connexion with some genetic implications of Levine's interpretation of erythroblastosis. Levine's hypothesis postulates a form of adverse selection restricted to heterozygous offspring of a particular

class of matings and not usually affecting first-born. Selection intensity therefore depends both on the frequency of the gene *rh* and on the size of the family. During the summer I made an examination of the theoretical consequences of these assumptions. The results, submitted for publication in full elsewhere, led to two conclusions: (*a*) the likelihood that *Rh*(+) is the manifestation of several dominant alleles of a multiple allele series in conformity with experimental data since then established; (*b*) the possibility that all such alleles are not equally efficacious with reference to the determination of hæmolytic anæmias of the newborn or stillbirths and miscarriages associated therewith.

From a theoretical point of view the outstanding anomaly of Levine's hypothesis is the very high incidence of a gene subject to fairly intense adverse selection. If μ is the net mutation-rate to a recessive gene of frequency r from one or more dominant alleles, s being the negative coefficient of selection for the heterozygous class as a whole, the condition of equilibrium between mutation and mortality is given by the relation:

$$\mu = \frac{sr(1-2r)}{1-sr}.$$

Various considerations, including remarkably close correspondence between figures for incidence of *Rh*(−) based on samples collected from widely separated localities, justify the supposition that an equilibrium state exists. On the basis of available vital statistics with respect to general incidence of erythroblastosis and the proportion of stillbirths or miscarriages attributable to the same mechanism, we may assign a lower limit to s. We then find that μ is much higher than any single-gene mutation-rate as yet recorded in the laboratory or in the field. On the other hand, its value is not inordinately high if we interpret μ to signify the rate of mutation at the *rh* locus from *any one of a series* of 5 or more dominant alleles. Conclusions at which Wiener and Landsteiner in America and Race, Taylor *et al.* in Great Britain have independently arrived at from observation, thus tally with what one would have strong grounds for assuming to be true from purely theoretical considerations.

What is more important in connexion with further work is that the distribution defined by the equilibrium condition stated above may depart very considerably from a random distribution calculated on the assumption that selection and mutation are negligible. The appropriate equations for gene frequency analysis must therefore make μ and s explicit. They are quite straightforward, if we know s. At present, there are insufficient reliable statistics of the general incidence of erythroblastosis fœtalis or of the fœtal and neonatal mortality associated with it. By the same token there are insufficient data for evaluating precisely what contribution iso-immunization makes to the etiology of erythroblastosis fœtalis. What is certain in the light of statistics already to hand is that second or later born heterozygous offspring of *Rh*(−) mothers by *Rh*(+) fathers are far more numerous than recognizable cases of neonatal hæmolytic anæmia and associated miscarriages or stillbirths.

It is therefore pertinent to emphasize a consideration insufficiently realized by workers in the clinical field. Where the end in view is to assay the importance of serological incompatibilities as agencies ontributory to fœtal and neonatal mortality, samples collected because of recorded erythroblastosis within a fraternity, and afterwards tested for the blood grouping of parents and offspring or for the anti-body titre of the mother, may be misleading. We should proceed from the opposite direction, that is, collect *entirely random* samples of offspring by parents of particular blood groups in order to determine the incidence of erythroblastosis, stillbirths and miscarriages, together with the blood groups of the offspring. Large enough samples both of matings *Rh*(+) father by *Rh*(−) mother and (as a control group) *Rh*(+) mother by *Rh*(−) father, should then give us all essential data for a just appreciation of the value of Levine's hypothesis and all relevant data for a determination both of the mutation-rate (μ) at a human locus and of the selection coefficient (s) of the *rh*–*Rh* system. Under war-time conditions, the possibility of getting such samples at blood transfusion depots is not fanciful.

LANCELOT HOGBEN.

Department of Zoology,
University of Birmingham.
Nov. 14.

[1] Race and Taylor, NATURE, 152 300 (1943).
[2] Race, Taylor, Boorman and Dodd, NATURE, 152, 563 (1943).
[3] Wiener and Landsteiner, *Proc. Soc. Exp. Biol. and Med.*, 53, 167 (1943).

An Interferometric Procedure for the Examination of Crystal Surfaces

THE accompanying photographs illustrate a high-precision interference procedure which has been developed for the examination of the contours of the surface figure on the surfaces of crystals. The method employed is an adaptation of Fabry and Perot's modification (made in 1897) of Fizeau's standard method for examining the perfection of optical flats with localized fringes. It is essentially a multiple beam interference procedure, depending for its precision on the employment of many interfering beams, and is easiest to apply to reasonably large crystalline surfaces which are moderately plane. A transmitting high-reflecting coefficient thin silver film (reflecting coefficient about 0·85) is deposited upon the untouched crystal face by evaporation *in vacuo*. This silvered surface is then adjusted to be nearly parallel to a similarly coated good optical flat. The separation between the silvered surfaces is preferably a small fraction of a millimetre, but the actual value is not critical. A parallel beam of light from a small circular aperture illuminated by a green-filtered mercury arc is directed at normal incidence on to the silvered faces. Fringes of equal thickness form; but owing to the multiple reflexions these are extremely sharp and have an intensity distribution depending upon the reflecting coefficient in a manner identical with that of the normal circular Fabry-Perot fringes of equal inclination.

These localized fringes constitute true contour lines of the crystal surface if the optical flat is of very high precision, and the interval between a pair of fringes represents a change in surface height of half a wave. The method has been applied to the examination of the cleavage surfaces of mica, selenite and calcite, and also to a natural surface of a quartz crystal. Some striking facts have thus been revealed. Typical contours of mica and selenite are shown in the accompanying reproductions.

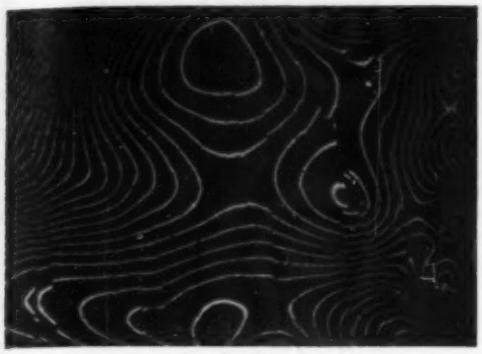


Fig. 1. MICA.

Fig. 1 shows a typical mica cleavage surface, the area represented being about one square centimetre. All mica surfaces so far examined reveal similar patterns. The highly advantageous intensity distribution is clearly evident. The fringes are very sharp narrow lines, occupying a small fraction of the distance between orders. The strong fringes are due to the green mercury line, the weaker doublet being the yellow lines. These permit identification of orders to be unambiguous. Without going into the finer points of detail, three main features are apparent: (1) The general contour of the hills and dales on the surface is rendered with startling clarity. (2) Sharp cleavage boundary lines appear. These represent steps of, in most cases, a fraction of a wave-length. The smallest step so far recorded is 40 A., which is only a few molecules. (3) The areas between the cleavage boundary lines may pass over hills and dales, but they are highly uniform, as evidenced by the smoothness of the fringes within the separate areas.

Fig. 2. SELENITE.

Fig. 2 shows in contrast a typical contour pattern for a good cleavage face of a crystal of selenite. The obvious characteristics are: (1) Absence of big-scale hills and dales as exhibited by mica. (2) Cleavage boundary lines all in the same general direction. (3) The fringes are nowhere smooth and continuous, but are quite ragged. Examination by high dispersion shows that the ragged feature originates in the fact that the surface exhibits a very large number of small facets differing in height by a small fraction of a wave-length.

It is clear that this experimental procedure has considerable potentialities in revealing the finer details of the surface structure of crystals. The highly sharpened fringes permit of very great precision, and cleavage steps of the order of but a few molecules thick can be detected and measured. This is, of course, far beyond the range of the microscope. A step only 30 A. in height could be detected.

Further details of procedure and specific results relating to mica, selenite, calcite and quartz will be communicated elsewhere.

S. TOLANSKY.

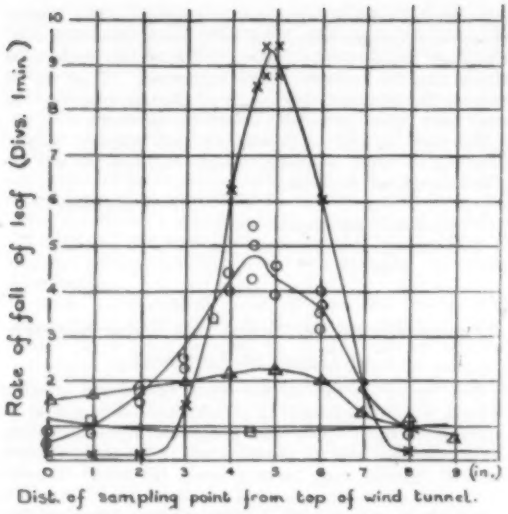
Physics Department,
University, Manchester.
Nov. 18.

Use of Radon to Trace the Flow Pattern of Gases in Furnaces

IN the operation of furnaces, the mean mixing length, l, of the gases[1] is of importance (as it is in aircraft design) since the processes of combustion, heat transfer, and of reaction with the surface being heated depend very largely upon the mass transfer of gas in directions normal to the main flow. The method of calculating l from observations of the temperature distribution in the wake of a hot wire is inapplicable for furnaces, and most chemical methods are also precluded by the relatively high temperatures and the impurities present. The use of a radioactive gas, on the other hand, offers a method which is not subject to these difficulties, since the activity is unaffected by temperature and by chemical reactions.

A series of experiments carried out in a home-made wind tunnel (cross-section 25 cm. × 25 cm.) has shown that the method is quite practicable. A 20 millicurie sample of radon was mixed with air in a gas-holder of about 350 litres capacity, and the mixture injected at 0·15 litres/min. into the centre of the main air stream, the volume-rate of which was 4,000 litres per min. The aperture was of such size as to give the radon-air about the same linear velocity as the main stream. Samples of the gas were drawn off through probe tubes placed at various distances and positions downstream. The samples were drawn through a tower containing cotton-wool and calcium chloride, and then passed into the chamber of an inverted Rutherford-type emanation electroscope which was alternately charged and evacuated several times. The top of the chamber was then removed and a standard Ministry of Food tin, with lid bored to fit over the insulator, inserted, a fresh tin being used for each reading. In this way the effect of recoil atoms was made negligible and a very low natural leak obtained (approx. 0·17 div./min.). Curves obtained with this apparatus are reproduced, the abscissa being the vertical height of the probe point in the tunnel, and the ordinate the relative activity of the sample in scale divisions per minute. It will be seen that the curves corresponding to sampling planes near the inlet point, where the effect of the walls is small, obey the Gaussian error law sufficiently well to be used for calculation of the mean mixing length. The relative spread ($\frac{1}{2}$ value width) and relative maxima of the curves also show the expected order of agreement with theory.

These results were considered to justify the attempt to apply the method to furnace systems, and preliminary trials have accordingly been made in a glass-melting furnace which have shown that no unexpected difficulties arise. The method can be used



DISTRIBUTION OF RADON IN THE WAKE OF A POINT SOURCE. SAMPLING PROBE AT POSITION 1A, ×; AT 2, ○; AT 3, △; AT 6, □.

not only for measurements of l but also of the cross flow from one furnace port to another. By introducing the active gas suddenly it can be used for the detection of regions of very low gas velocity; and by measuring the relative activity in a single pipe after perfect mixing is attained, it can be used for metering hot raw gases continuously—a technical problem of very great difficulty and importance.

It is proposed to improve the technique by the use of an electrometer valve to increase the convenience of measurement for field work, and possibly by the development of continuous methods of removing the recoil atoms.

Our thanks are due to Dr. N. Feather, Prof. S. Russ and Mr. R. Siday for advice on the radioactive technique, and Mr. P. R. Chase for carrying out much of the experimental work; also to the Medical Research Council for the radon used in these experiments.

R. MAYORCAS.
M. W. THRING.

British Coal Utilisation Research Assoc.,
Experimental Station,
Rickett Street, London, S.W.6.

[1] Goldstein, S., "Modern Developments in Fluid Dynamics" (Vol. 1), 214.

A New Water-Soluble Polysaccharide from Perennial Rye Grass Pasture

A WATER-SOLUBLE polysaccharide containing galactose and glucose residues has been isolated from perennial rye grass pasture. Repeated fractional precipitation from aqueous solution by alcohol and acid-alcohol followed by prolonged dialysis did not effect appreciable reduction of the high ash content (more than 30 per cent) of the polysaccharide. Since the ash consisted of calcium sulphate, it is suggested that the polysaccharide may occur as the calcium salt of the sulphuric ester of a polygalactose with one or more glucose residues incorporated in the carbohydrate moiety.

The aqueous solution of the polysaccharide was neutral in reaction, reduced Fehling's solution, and gave a positive rotation, $[\alpha]_D^{16°} + 40°$ ($C = 0{\cdot}125$).

The galactose was identified as mucic acid, m.p. and mixed m.p. 214° C., and the glucose as acid potassium saccharate, which was converted to the silver salt. No other sugars were found.

All previously reported galactans appear to be of algal or fungal origin and the few known polysaccharide sulphuric esters, for example, agar[1], fucoidin[2], etc., have been extracted from the same sources. On the other hand, the polysaccharide herein described is of higher plant origin.

R. J. MCILROY.

Canterbury University College,
Christchurch, C.1,
New Zealand.
Aug. 18.

[1] Jones, W. G. M., and Peat, S., *J. Chem. Soc.*, 225 (1942).
[2] Bird, G. M., and Haas, P., *Biochem. J.*, **25**, 403 (1931).

Microbiological Assay of Riboflavin

IN his letter appearing under the above title[1], Dr. F. C. Happold criticizes the procedure used by Dr. E. C. Barton-Wright and Mr. R. G. Booth[2] in the determination of riboflavin, and insists on the importance of calcium in the nutrient medium and mentions the work of Chattaway, Happold and Sandford[3]. The evidence in the latter paper to which he evidently refers consists in an experiment in which a series of increasing doses of calcium chloride was added to the nutrient medium. The authors do not seem to have appreciated fully a limiting factor in the very low solubility of calcium in the presence of excess of phosphate at pH 6·6–6·8. The solubility product of tricalcium phosphate is about 10^{-32}, but may be perhaps 10^{-31} in the presence of the other minerals contained in Chattaway, Happold and Sandford's nutrient medium[4,5].

Calculation shows that the quantity of calcium soluble under the conditions of their experiment is the equivalent of 0·0028 ml. of 0·5 per cent calcium chloride in the 20 ml. of medium used, whereas additions ranging from 0·1 to 0·8 ml. were made. Virtually the whole of the added calcium would be precipitated. It is true that the addition of calcium chloride was delayed until after sterilization of the main part of the medium, but subsequent precipitation during the seventy-two hours at 37° may be taken as certain. In the absence of precise knowledge of certain factors—the time taken for such precipitation to occur, how soon inoculation followed the preparation of the flasks of medium, whether or not precipitation preceded the main growth of the bacteria, and if so its effect on the latter when settling to the bottom of the flasks, etc.—it is impossible to state what effects were exercised by the added calcium. At least it seems certain that the direct conclusion that calcium stimulates growth of the Lactobacillus is not warranted by the experimental evidence cited.

R. H. HOPKINS.

University of Birmingham.
Nov. 8.

[1] Happold, F. C., NATURE, **152**, 414 (1943).
[2] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, **37**, 25 (1943).
[3] Chattaway, F. W., Happold, F. C., and Sandford, Mary, *Biochem. J.*, **37**, 298 (1943).
[4] Holt, E., La Mer, V. K., and Chown, H. B., *J. Biol. Chem.*, **64**, 509 (1925).
[5] Hopkins, R. H., and Amphlett, P. H., *J. Inst. Brew.*, **45**, 365 (1939).

A Penicillin-like Substance from *Aspergillus giganteus* Wehm.

THE production of antibiotic substances by several species of Aspergillus has been reported, and several have been purified or isolated[1–5]. Wilkins and Harris[6] described the production of a substance, active against staphylococci, by *Aspergillus giganteus*. A culture of the mould (kindly supplied by Dr. Wilkins) was grown on a medium consisting of malt extract, 2 per cent, peptone, 1 per cent, *M* triethanolamine buffer *p*H 8·2, 5 per cent. The antibiotic has been purified and a crystalline degradation product prepared. In all its chemical and biological properties it appears to be very similar to penicillin[7].

Although the mould produces much less pigment than *Penicillium notatum*, the yield of the antibiotic is lower and the purification no easier than that of penicillin.

It is suggested that this substance be called *gigantic acid* to indicate its source.

It is of interest that the production of antibiotics chemically similar to penicillin is not limited to the genus Penicillium, but that they are produced by at least two species of Aspergillus, namely, *Aspergillus giganteus* and *Aspergillus flavus*[3, 4].

Full details of this work will be published when publication conditions permit. I am indebted to the Agricultural Research Council for a personal grant.

FLORA J. PHILPOT.

Sir William Dunn School of Pathology,
University of Oxford. Nov. 10.

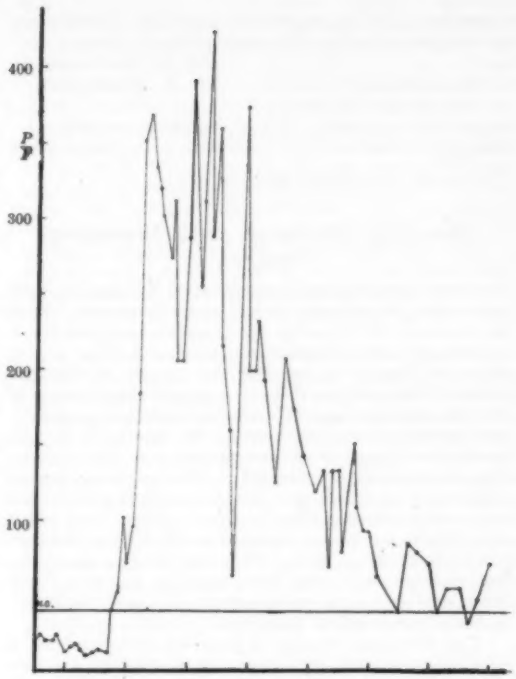
[1] White, E. C., *Science*, **92**, 127 (1940).
[2] Waksman, S. A., Horning, E. S., and Spencer, E. L., *Science*, **96**, 202 (1942).
[3] Bush, M. T., and Goth, A., *J. Pharm. Exp. Therap.*, **78**, 164 (1943).
[4] McKee, C. M., and MacPhillamy, H. B., *Proc. Soc. Exp. Biol. Med.*, **53**, 245 (1943).
[5] Glister, G. A., NATURE, **148**, 470 (1941).
[6] Wilkins, W. H., and Harris, G. C. M., *Brit. J. Exp. Path.*, **23**, 166 (1942).
[7] Abraham, E. P., and Chain, E., *Brit. J. Exp. Path.*, **23**, 103 (1942).

Lipæmogenic Activity of Pituitary Extracts

Frazer and Stewart[1, 2] have described the chylomicron count method for assessing the level of blood-fat, and have used it to follow the effects of starvation and standard meals in man. Stewart[3], using this method, has also observed lipæmias in rabbits after severe hæmorrhage.

In the course of some experiments on rabbits we have noticed that lipæmias have frequently followed the subcutaneous injection of certain extracts prepared from pituitary glands. The work has now been discontinued, at any rate for the time being, but we have thought it worth while briefly to record our own observations as to the frequency with which these lipæmias occur and the courses they run.

The most striking feature is the extreme variation in their intensity. Thus, 27 rabbits were injected with the same amount of a pituitary extract; 4 showed no lipæmia, 21 gave maximum chylomicron counts between 5 and 10 times the normal, while 2 animals developed lipæmias so intense that they were visible to the naked eye, the particles being too densely packed to be counted. The accompanying figure illustrates the characteristic course of the lipæmia in one rabbit. Counts were made every five minutes for four hours following the injection, then at ten-minute intervals for one hour and again at five-minute intervals for a further two hours. Whenever the lipæmia could be assessed by this method, that is, in the 21 rabbits mentioned, it began between forty and fifty minutes after injection and rose rapidly to a maximum during the next thirty minutes. In animals giving the higher counts the lipæmia was sustained for an hour: there followed a general decline in count such that normal values were reached five hours after the injection, though transitory small increases occurred during the fall and for a further two hours.



$\frac{P}{p}$ = particles per microscope field; ↑ indicates time of injection; *N.C.*, average pre-injection 5 mm. chylomicron count of 21 starved rabbits.

Marked fluctuations in the chylomicron count occurred throughout the period of observation; it was, however, noticed that the ascending portions of the curve were invariably steeper than the descending, especially during the period of maximum lipæmia. We incline to the view that this phenomenon occurs because the particles are injected into the circulation through the thoracic duct. Further, the general course of the curves suggests that fat is entering the circulation by this route for at least one hour after the initial rise.

The extracts used were prepared from desiccated frozen whole sheep pituitaries. They were good sources of thyrotrophin and gonadotrophin, but had been substantially freed of prolactin, containing less than 5 per cent of the quantity extractable from the equivalent weight of dried gland. The extracts also showed appreciable pressor and oxytocic activities.

The extracts were further found to be a potent source of the factor that raises the liver-fat content of adult guinea pigs. Control extracts prepared from sheep muscle raised neither the fat content of guinea pig livers nor the chylomicron count of rabbit blood. We therefore regard the experiments reported here-

as evidence for the view that these two effects may be brought about by the same pituitary factors.

M. R. A. CHANCE.
Glaxo Laboratories, Ltd., T. R. MIDDLETON.
Greenford, Middlesex.

[1] Frazer, A. C., and Stewart, H. C., *J. Physiol.*, **90**, 18 (1937).
[2] Frazer, A. C., Stewart, H. C., and Elkes, J., *J. Physiol.*, **95**, 68 (1939).
[3] Stewart, H. C., *J. Physiol.*, **101**, *Proc.* (1942).

Binocular Focusing on a Repeating Pattern

SOME correspondence appeared in NATURE in 1938 about the phenomenon described by Brewster[1], which is obtained by focusing on a surface covered by a repeating pattern while converging on a point nearer than, or beyond it, so that the images of different units of the pattern fall on corresponding points of the two retinæ. Paget[2] found that when he converged, the patterned surface seemed to approach to the position of the point of convergence, the units appearing correspondingly smaller. This experiment has now been tried on eight subjects, and Paget's result only obtained with four of them. They were asked to estimate, and then indicate with a ruler, the distance and size of the pattern. Two saw the images at the distance for which they were focusing, however much they squinted, and two saw them in a rather indeterminate intermediate position.

The divergent results of previous investigators of the factors underlying judgments of absolute distance seem to be due partly to differences in their experimental methods, and partly to the very limited number of subjects studied. It can be shown by using only a tiled floor or striped wallpaper, a tape-measure, and a piece of thread, that the estimate of absolute distance can vary widely with the subject and the conditions of the experiment. A satisfactory arrangement for such an experiment must provide that: (1) the illumination is constant; (2) the size of the retinal image is constant; (3) the object to be observed can be clearly focused; (4) the object fills the whole visual field so that there is nothing else with which to compare it; (5) the distance of the 'marker' used to indicate the position of the image can be accurately judged; (6) the 'marker' is not visible until the position of the image has been judged, otherwise estimates are purely relative. The apparatus of Carr and Swenson[3] neglects point 3, that of Grant[4] point 5, and that of Fischer and Löwenbach[5] points 4 and 6.

The repeating pattern fulfils all these requirements; the difficulty arises in choosing a suitable 'marker'. If a piece of thread was used, the apparent position of the pattern varied according to whether the thread ran sagittally or from right to left. In the latter case, when the thread could only be located by focusing, two of the subjects could not tell where it or the images were; but all who could make a judgment in both sets of conditions located the images nearer the point of convergence with the thread running sagittally, and therefore easy to converge upon. The two 'focusers' still saw the pattern well beyond the point of convergence. When one of the 'intermediate' subjects, who usually located the image not far from the plane on which he was focusing, held the thread sagittally at the point of convergence, he found that the pattern "floated up and sat on it", dropping down again when he removed the thread. An apparatus which uses as a 'marker' a vertical rod visible all the time therefore begs the question. The type of pattern used also affects the results; the two subjects who tested this point located vertical lines nearer the eye than a diagonal grid.

When the subjects were given a rough test for their stereoscopic acuity, their quickness and accuracy varied directly with the degree to which they used convergence for assessing distance. Variation in the observers and in the type of floating mark or grid used in the apparatus may be of importance in the interpretation of air photographs.

In my view, contrary to most recent opinion, fine stereoscopic discrimination, in some people, does depend on small changes of convergence. It is hoped to make some more refined experiments to investigate this point.

NELLIE HENDERSON.
King's College,
Newcastle upon Tyne. Nov. 18.

[1] Brewster, D., *Phil. Mag.*, **30**, 305 (1847).
[2] Paget, Sir R. A. S., NATURE, **142**, 77 (1938).
[3] Swenson, H. A., *J. Gen. Psychol.*, **7**, 360 (1932).
[4] Grant, V. W., *J. Exp. Psychol.*, **31**, 89 (1942).
[5] Fischer, M. H., and Löwenbach, H., *Pflüg. Arch. ges. Physiol.*, **236**, 607 (1935).

J. B. Hannay and the Artificial Production of Diamonds

IT seems to be a well-established fact that Hannay did make diamonds, and as the result of an investigation which, in my memoir[1] of him, I described as difficult, and carried out in a masterly manner. That work like this would be scoffed at, and the mere evidence that could be put forward at the time discounted, was to be expected. It will be remembered that, when the discovery of argon was first announced, there were plenty of critics ready to suggest that the announcement was made on altogether insufficient evidence, and to commit themselves to observations which no one would attempt to justify to-day.

It seems to me to be unfortunate that an attempt should be made[2] to justify Hannay's critics, rather than to find in his other investigations evidence that he really was no mere inventor, but a very clever investigator, who came to his discovery as the result of clear reasoning, followed by well-planned and boldly executed experiments. No one who has read his papers on the continuity of the gaseous and liquid states can fail to come to such a conclusion; and many of his minor investigations show insight and exceptional experimental skill.

Now there is a very definite reason why Hannay did not reply to the criticism to which Lord Rayleigh refers. In the middle 'eighties, before he was thirty years old, Hannay had entirely abandoned what may be termed academic experimental work, and thrown himself into industrial research. What he did, he put his whole heart into; and if the criticism came to his notice, it is scarcely to be imagined that it would interest him.

However, why should Hannay 'fake' a result of this kind? The letter from Ramsay to McGowan, which I publish in my memoir, shows that Hannay not only used but also made the apparatus referred to. The general experience is that errors of this kind are accidental; and as a matter of experience, we all make mistakes, even the youngest of us.

M. W. TRAVERS.
Little Mill, Pitchcombe, Stroud.

[1] *Chem. and Ind.*, **17**, 507 (1939).
[2] NATURE, **152**, 597 (1943).

SUBDIVISION OF INSECTA PTERYGOTA INTO SUBORDINATE GROUPS

By Dr. B. N. SCHWANWITSCH
State University of Leningrad, Saratov, U.S.S.R.

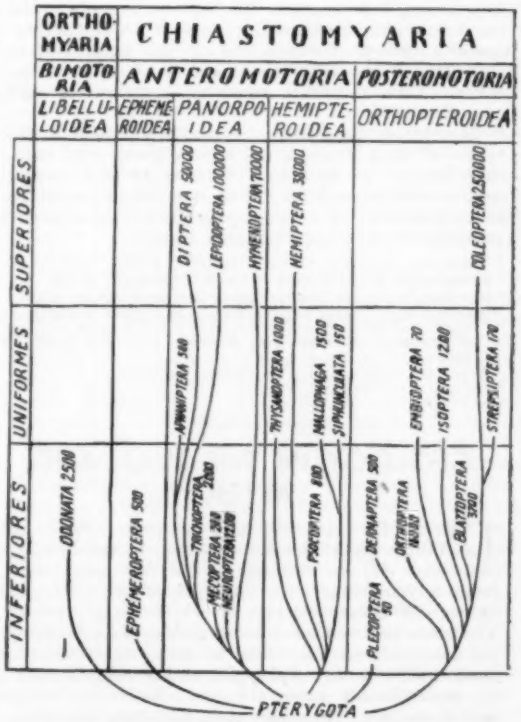
THE acquisition of wings is the most important factor upon which the unparalleled progressive evolution of insects depends. The development of liquid food feeding, though of great moment, plays only a subordinate part as compared with flight. Every order of the Insecta Pterygota shows its own type of wing, and the wing venation serves as a well-established systematic criterion, yet the functional significance of the almost endless variations in venation is as yet scarcely perceived. On the other hand, the musculature of wings shows considerable constancy in the majority of Pterygote orders, its principal modifications being few and functionally comprehensible. Therefore an attempt seems desirable to use 'the muscular motor of the wing' as a taxonomic criterion, especially for the much-needed grouping of insect orders into larger units.

There are two main types of wing motor musculature in insects[1,2]. One of them may be named chiastomyaric. In this, the levators of the wing are dorsiventral and the depressors longitudinal. The directions of the two systems thus cross over one another. Levators are lateral, depressors medial. With the exception of the Odonata, the alary musculature of all the Pterygote orders belongs to this chiastomyaric type. In Odonata the only pair of longitudinal muscles is weak, both the levation and depression being performed by dorsiventral muscles. Contrary to chiastomyaric forms, levators are medial and depressors lateral. Thus almost all the wing muscles of Odonata lie in the same direction and the muscular motor should be termed 'orthomyaric'.

On this basis the whole of the Pterygota can be divided into Orthomyaria and Chiastomyaria (see chart). In the Orthomyaria, that is, Odonata, the two pairs of wings and their motors are alike. Therefore the Orthomyaria represent a Bimotoria group. Among the Chiastomyaria, 'bimotorism' occurs only in the inferior groups like Neuroptera, Mecoptera, Plecoptera and some others, while the higher orders show a strong tendency for one pair of wings to dominate the other, with corresponding distinctions in the meso- and meta-thoracic muscles and skeleton. The process follows two directions. In Anteromotoria the fore-wing becomes dominant, while the hind one may either decrease, be lost (Cloëon), or transformed into a haltere (Diptera), and accordingly the mesothoracic motor is very much stronger than the metathoracic (Hymenoptera, Hemiptera, Lepidoptera. The opposite is the case in the Posteromotoria. Their fore-wings may either turn into elytra (Coleoptera, Dermaptera), or into halteres (Strepsiptera), or show a tendency to elytration (Blattoptera, Orthoptera), or undergo atrophy (many Phasmids), while the hind wings in some groups are either the sole or principal organs of flight. The thoracic skeleton and wing muscles are transformed accordingly, though the domination of metathorax in Posteromotoria is not so pronounced as that of mesothorax in Anteromotoria.

The latter group can be divided into three complexes of orders. One of these is the Panorpoidea, a generally acknowledged group (Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Diptera, Aphaniptera) that shows a strong tendency to proboscis formation and holometabolous metamorphosis. Since the last-mentioned two characters are also present in Hymenoptera, this order should also be included in the Panorpoidea, the erucoid structure of Tenthredinid larvæ being a supplementary proof of the relationship. Another complex is the Hemipteroidea accepted by Martynov[3] under the name of Paraneoptera and comprising the Hemiptera, Thysanoptera, Mallophaga, Siphunculata and Psocoptera. Hemipteroidea differ from Panorpoidea in a still stronger tendency to proboscis formation and an almost complete absence of holometabolous metamorphosis. To the third complex of Anteromotoria, namely, the Ephemeroidea, there belong the single order Ephemeroptera.

As to Posteromotoria, they consist of only one complex, namely, the Orthopteroidea, and contain on one hand the Orthoptera in the old sense of the word (Orthoptera, Blattoptera, Dermaptera), orders regarded[4] as related to them (Isoptera, Embioptera) and the Plecoptera, which show some orthopteroid affinities as well[4]. On the other hand, the Coleoptera with Strepsiptera are also included into the complex. Besides their posteromotorism their inclusion is favoured by the affinities of Coleoptera to some extinct cockroach-like forms[5], the almost total lack of proboscis formation; and their metamorphosis, though complete, is, however, nearer to the hemimetabolous form than to that of the Panorpoids[6].



A SYSTEM OF THE ORDERS OF INSECTA PTERYGOTA BASED MAINLY ON THE STRUCTURE OF WING MUSCULATURE (VERTICAL SUBDIVISION) AND GENERAL LEVEL OF ORGANIZATION (HORIZONTAL SUBDIVISION). CIPHERS AGAINST THE NAMES OF THE ORDERS INDICATE THE NUMBER OF SPECIES IN EACH.

The Orthomyaria consist of a single complex, Libelluloidea, with the single order Odonata.

Thus the whole of the Pterygote orders is subdivided into four complexes, all of which are fairly natural. Except for the positions of the Coleoptera and Hymenoptera, the subdivision corresponds with that proposed under different names by Martynov[3], though his criteria of classification differ widely from those given in the foregoing.

Besides this, the Pterygote orders may be classified under three series shown by the horizontal division of the chart. To the Inferiores belong those orders which show general morphological primitivism, middle- and large-sized body, mostly small numbers of species (excluding Orthoptera) and paucity of biological types (excluding Neuroptera). The Uniformes combine general primitiveness with some narrow specializations (mouth parts of parasites, asymmetrical head and mouth parts of thrips, silk glands of Embioptera). Minute body size, paucity of species and biological types and a strong tendency to apterism are also typical of the series. The Superiores consist of five orders which on account of their maximum morphological specialization, enormous numbers of species and biological types and the widest variability of body size should be regarded as undoubted peaks of insect evolution.

The interrelations of the horizontal and vertical divisions of the chart make it clear that, in each of the three main complexes (Panorpoidea, Hemipteroidea, Orthopteroidea), evolution follows the same course; namely, starting with primitive groups like Mecoptera, Psocoptera or Blattoptera, it leads to the maximum abundance of the forms of life in the progressive orders of Superiores on one hand and to the narrow specialization of the Uniformes on the other. Thus a definite structure is typical of each complex.

The system described is on one hand based on the types of wing mechanism, mouth parts and metamorphosis; on the other, it attempts to take into account the general 'height' of organization, and thus make a distinction between primitive, regressive and progressive orders of Pterygote insects.

[1] Weber, H., "Grundriss der Insektenkunde" (1938).
[2] Snodgrass, R. E., "Principles of Insect Morphology" (1935).
[3] Martynov, A. V., "In Filipjev's Opredelitel nasekomykh" (1923).
[4] Martynov, A. V., "Etudes sur l'histoire geologique et de phylogenie des ordres des Insectes (Pterygota) I. Palaeoptera et Neoptera-Polyneoptera". *Travaux Inst. Paleont., Acad. Sci. USSR.*, 7 (1938).
[5] Weber, H., "Lehrbuch der Entomologie" (1933).
[6] Berlese, A. G., "Insetti", 2 (1925).

GEOLOGY IN THE WAR AND AFTER

DR. E. B. BAILEY, in a lecture to the Royal Philosophical Society of Glasgow, delivered on November 17, on "Geology in the War and After", dealt in particular with the work of the Geological Survey of Great Britain, of which he is director. The main war aim has been to give useful advice on: (1) home mineral resources, so as to meet essential needs with economy of shipping and foreign currency; (2) underground water, for new aerodromes, camps and factories; (3) subterranean facilities, for storage and personnel. Coal is the main mineral asset of Great Britain. Two interesting current problems occupy a considerable share of the Geological Survey's time: first, the resurrection, with modern equipment, of coal outcrop working, and second, the correlation of coal seams. Correlation work has been intensified because confused nomenclature impedes progress that may be expected from the recent unification of ownership in the hands of the State. In its coal work, the Geological Survey co-operates closely with another branch of the Department of Scientific and Industrial Research, namely, the Fuel Research Board, the concern of which is with the quality of the coal seams.

Iron comes second only to coal in importance. Iron ore at present is mostly won from bedded ores in the English Midlands, exploited, as in the case of coal crops, with mechanical diggers. The Survey has done much to help in this wide field. Elsewhere it has directed attention to valuable veins of low-phosphorus iron-ore and has guided their successful development. In regard to non-ferrous metals, the Survey has had successes, but perhaps it is wiser not to particularize. Among non-metallic vein minerals, special attention may be directed to fluor. The Survey warned the steel industry of a possible fluor shortage, and played its part in averting trouble. One important step was to interpret the shape of a particular fluor body, which allowed of ordered replanning of mining operations. In this matter Canadian miners, now sappers, helped greatly by teaching British comrades a novel technique. Felspar may be mentioned here, as a mineral in which, through Survey advice, Great Britain has passed from zero production to self-sufficiency, even in the most exacting grades required for dentures.

Sand and gravel are, of course, always in demand. The year 1939–40 was 'sand-bag year' for London. The coming of war called for rapid reinforcement of existing buildings, and the Survey indicated the particular parks and open spaces where sand-bags could be filled. The Civil Defence authorities have estimated the resultant saving at £125,000. Moreover, external roads and railways were freed for other traffic. Sand of suitable quality for the manufacture of optical glass had been located by the Survey so long ago as 1921, and its significance constantly stressed in the proper quarter during ensuing years. The reward came in 1940, when all Continental sources of this strategic mineral passed into enemy hands. Mica, essential in electrical apparatus, has also been found, of good quality and useful amount.

The importance of the Survey's store of digested information in regard to underground water and underground possibilities of excavation is self-evident. Many inquiries also have been answered upon matters of overseas geology. As a rule, the information has been supplied from the Library; but one member of staff has the privilege of serving as geological adviser in the Central Mediterranean Force, and another was able to visit Malta last spring.

In conclusion, Dr. Bailey expressed the hope that geology would play as useful a part in reconstruction as in war, and that geologists would remember in the future, as in the past, that man does not live by bread alone; in other words, once victory has brought the present emergency to a close, geologists will return to wrestle with the rocks to win from them treasures, intellectual as well as material. It is of happy augury that a geologist, Prof. A. E. Trueman of the University of Glasgow, has been appointed to the small committee that leaves for West Africa in the New Year entrusted with a mission that depends for success upon a combination of good-will, good sense and technical knowledge.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN AUSTRALIA

THE sixteenth annual report of the Department of Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1942. A large part of the Department's activities is now devoted to the solution of problems arising out of the War, and to assistance and advice to various Government Departments and other institutions and organizations concerned with the war effort, reference to which activities is confined to brief statements or omitted entirely. Among such investigations are those on flax production, vegetable seed production, the possibilities of native and exotic Australian plants for rubber production, the planting and testing of rubber-producing plants from various parts of the world, the storage of foodstuffs and wool and the development of special rations and high vitamin-content extracts for the use of the various Services.

Plant investigations in the field of vegetable fibres have included studies of the microbiology of dew retting and of the actual process of retting to ascertain whether improvement is possible in practice, investigations on pastures and weeds as well as on fruit, although that on general storage disorders has been curtailed. Potato investigations have included a study of virus disease, and a study of the effects of virus *X* on yield has been concluded. Tobacco investigations have been curtailed; but drug-plant investigations have included the extraction of hyoscine and atropine, opium alkaloids, digitalis, ephedrine, ergot, quinine and strychnine, santonin and felix-mas, pyrethrum and native plants as sources of medicinal drugs.

Entomological investigations have covered insect pests in stored wheat and in stored wool, including tests of possible control methods, the insect control of noxious weeds, as well as sheep blow-fly. Other work has been concerned with the development of fly and mosquito sprays, the control of the Australian plague locust, and tests of insecticides designed to control the red-legged earth mite in pasture land. Nutrition investigations at the Animal Health Research Laboratory, Melbourne, have covered pleuro-pneumonia of cattle and mastitis in dairy cattle, while the McMaster Animal Health Laboratory has continued its studies on the administration of phenothiazine, investigations on the efficiency, and economy in the use, of anthelmintics and on external parasites of sheep.

The field staff of the Division of Soils has continued its work, but on a smaller scale, and the Division has also continued spectrochemical work on soils, including a survey of the metallic composition of surface soil at the Waite Institute, problems of anion exchange, with particular reference to the fixation of phosphoric acid, and the determination of small amounts of copper in soil and its availability to plants. No new major lines of investigation have been commenced by the Forest Products Division. Work has continued on the study of fundamental problems on behalf of the Australian pulp and paper industry on the investigation of wood structure in relation to properties, timber seasoning and timber physics, and on wood preservation, as well as on veneering and glueing.

The re-organization of the Division of Food Preservation and Transport has been completed, and all its officers are now engaged on problems of direct importance to the war effort, and chiefly those relating to the canning and drying of foodstuffs. Many investigations on cold storage have been temporarily abandoned. The great expansion in vegetable canning has raised many problems in general canning technology which the Division has been called upon to solve, and the Division undertook a broad investigation into the effect of each step in the canning process on the loss of vitamins in canned vegetables, especially the green-leaf vegetables, cabbage and silver beet. The canning of bacon rashers has been a major investigation. The problem has been to give canned bacon a heat treatment adequate to prevent spoilage and yet not so severe as to destroy the quality of the pack, particularly in relation to texture and form of the rashers. Investigations into substitute materials for the manufacture of foodstuff containers have been carried out. With regard to dried foodstuffs, investigations during the year have been concerned with dried eggs and vegetables. In connexion with experiments on skin coatings for apples, nine different fungicides are being tested for use as control agents to prevent mould waste. Fruit storage investigations on apples have covered the preparation of emulsions of wax, oil, and mixtures of wax and oils, and of their effects on water-loss from fruit and on the resistance of the fruit to the diffusion of oxygen and carbon dioxide. Fundamental work is being conducted on the effect of the thickness of various skin coatings in relation to the size, maturity and the variety of fruit and the temperature of storage.

Fisheries investigations have covered a wide range with a view to the possible development of pelagic fisheries, including investigations on tuna, pilchards and anchovy, and the improvement of methods of mass catching of inshore fish such as salmon for cannery purposes. A survey of the distribution and biological characteristics of edible and other sharks has been inaugurated with the view of stabilizing or, if possible, increasing the supply of oils rich in vitamins from the recently established successful fish-oil industry. Research on agar has been intensified and studies have been commenced on the preparation of carrageen (Irish moss).

The activities of the National Standards Laboratory have again been largely directed to defence work, including the examination of gauges and measuring equipment, calibration of testing machines, the testing of optical munitions instruments, measurement of the optical properties of melts of optical glass manufactured in Australia, and pyrometry calibration for the Ministry of Munitions. The Aeronautical Division has been increased considerably during the last two years, and is co-operating closely with the Australian Advisory Committee on Aeronautics. The development of methods of construction with synthetic resins is proceeding satisfactorily, and the position in regard to testing equipment for engines has been considerably improved. The Instruments Section has designed and constructed a noisemeter, a recording accelerometer and resistance strain gauges. The Division of Industrial Chemistry has carried out further investigations on the Freney-Lipson process for reducing the shrinkage of wool as well as on the Woolindras process. Attention has also been concentrated on fellmongering, including a physical method of following the depilation of sheepskins, the mechanism of sweating, chemical sterilization of sheepskins and identification of bacteria capable of depilating sheepskins. Attention has also been given

to physico-chemical investigations on the flotation of sulphide and non-sulphide ores, and to foundry sands; and an investigation on ethylene as a starting material for the synthesis of commercially valuable organic chemicals has been initiated, including the manufacture of ethylene chlorohydrin. Investigations in the field of synthetic resins have also been commenced, and the building up of a research organization for dealing with friction, lubrication, bearing and wear problems has been continued under which investigations on the theory of metallic friction and the role of shearing and ploughing and on the friction of thin metallic films have been carried out. Other investigations in this field have been concerned with the testing of bearing metals and bearings, the mechanism of lubrication, extreme pressure lubricants, cutting fluids, and the development of lubricants for drawing and pressing, as well as the lubrication and wear of piston rings and cylinders, and the wear and oil-contamination of producer-gas vehicles.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, December 18

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. L. Jánossy: "Cosmic Rays".

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (Joint meeting with the ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY) (at 16 Prince's Gate, South Kensington, London, S.W.7), at 2.30 p.m.—Exhibition of Scientific Photographic Apparatus.

Monday, December 20

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. Evert Barger: "Some Problems of Central Asian Exploration" (Tenth Asia Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. W. Muckle: "Some Considerations in the Application of Light Alloys to Ship Construction".

Tuesday, December 21

UNION DES INGENIEURS ET TECHNICIENS DE LA FRANCE COMBATTANTE (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 4.30 p.m.—Colonel P. Baranger: "La Reconstruction et l'éducation technique".*

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Otto Friedmann: "Some Czechoslovak Folkways".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SCIENCE TEACHER at the Flint Day Continuation School—The Director of Education, County Education Offices, Mold, Flintshire (December 24).

LECTURER IN SCIENCE at the F. L. Calder College of Domestic Science (to be responsible for the teaching of Science applied to Domestic Subjects and of Hygiene)—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool 1 (December 27).

ASSISTANT TEACHER OF MATHEMATICS at the Selby Art School and Technical Institute—The Secretary to the Managers, Education Offices, Garforth, near Leeds (December 31).

SPECIALIST TEACHER OF STAMMERING—The Director of Education, Education Offices, Burnley (December 31).

LECTURER IN HIGH VOLTAGE ENGINEERING, and an ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Registrar, College of Technology, Manchester 1 (December 31).

TEACHER IN ENGINEERING SUBJECTS (possessing Graduate or equivalent qualifications in Mechanical Engineering and Industrial experience) at the Melton Mowbray and District County Technical College—The Director of Education, County Education Office, Grey Friars, Leicester (January 6).

GRADUATE (temporary) FOR MECHANICAL OR CIVIL ENGINEERING SUBJECTS, together with MATHEMATICS, at the Denbighshire Technical College, Wrexham—The Director of Education, Education Offices, Ruthin, Denbighshire (January 8).

Acting full-time DEMONSTRATOR OF ANATOMY—The Dean, Medical College, St. Bartholomew's Hospital, London, E.C.1 (January 11).

ENTOMOLOGIST in the Department of Agriculture, Salisbury, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, 429 Strand, London, W.C.2 (January 31).

LECTURER ON PHYSICS—The School Secretary, St. Mary's Hospital Medical School, London, W.2 (February 1).

ASSISTANT ENGINEERS (CIVIL) for the Government Railways in West Africa—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.778A).

DOCKYARD MANAGER for the Sudan Railways (candidates should be fully trained Marine Engineers holding University Engineering Degree or A.M.I.Mech.E. or A.M.I.N.A.)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1966a).

ASSISTANT MASTER or MISTRESS to teach GEOGRAPHY, and an ASSISTANT MASTER FOR ENGINEERING, in the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent.

CHIEF TECHNICAL OFFICER—The Secretary, Warwickshire War Agricultural Executive Committee, 6 Guy's Cliffe Avenue, Leamington Spa.

TEACHER (temporary) OF MATHEMATICS to junior engineering students—The Principal, County Technical College and School of Art, Newark, Notts.

GRADUATE ASSISTANT to teach PHYSICS (industrial and teaching experience desirable), and a GRADUATE ASSISTANT for subjects up to Higher National Certificate standard in MECHANICAL ENGINEERING (candidates must have had practical experience in Engineering and be able to teach ELECTRICAL ENGINEERING to the Ordinary National Certificate standard), at the West Hartlepool Technical College and Technical Day School for Boys—The Chief Education Officer, Education Offices, Park Road, West Hartlepool.

SPEECH THERAPIST in School Clinics for the Remedial Treatment of Stammering and other Speech Defects—The Director of Education, Education Offices, Todmorden, Yorks.

GRADUATE ASSISTANT MASTER FOR ENGINEERING SUBJECTS WITH MATHEMATICS in Day Technical School and Evening Institute—The Principal, Technical Institute, 28 Beckenham Road, Beckenham, Kent.

REPORTS and other PUBLICATIONS

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